Light and

LIGHTING

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Stanton Type 8 Prestressed Spun Concrete Lighting Columns at Banbridge, County Down.

STANTON PRESTRESSED SPUN CONCRETE LIGHTING COLUMNS

The type shown is part of a wide range of Stanton designs approved by the Council of Industrial Design. All Stanton Group 'A' Columns are acceptable to the Ministry of Transport for use on trunk roads.

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- PRESSURE PIPES
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THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Light and
LIGHTING

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contents

Factory Lighting

HAPPILY the time has passed when the artificial lighting of factories was difficult to contrive in a highly satisfactory manner. To-day, very efficient light sources and well-designed lighting equipment are available for providing good lighting in factories at reasonable cost. Also available are the services of competent lighting engineers who can assess the requirements for different industrial purposes and then plan the application of the lighting industry's products to the best advantage of users. Happily, too, industrialists in general now give to the problems of lighting in their establishments more serious consideration than was the custom of many of their predecessors. This is undoubtedly due to a better appreciation of the importance of good seeing in relation to productivity, accident prevention and worker satisfaction. But, of course, "sufficient and suitable" lighting in all factories has been a statutory requirement since 1937, and other factors also have operated to bring about widespread improvement in factory lighting since then. Standards better than the least the law demands are necessary to obtain the best results. The standards of lighting recommended in the IES Code can be improved upon with profit although, so long as these standards are achieved, not only will the law be satisfied but conditions will be compatible with a high level of productivity so far as this depends on visual efficiency and comfort. Good natural lighting of factories is obviously desirable whenever and wherever it is reasonably practicable to get it but, failing this, good modern artificial lighting is an excellent substitute.

Notes and News

THE 1957-58 session of the Illuminating Engineering Society opens on Tuesday, October 8, when the new President, Mr. E. B. Sawyer, will present his Presidential Address, entitled "Designing for Harmony," at the Royal Institution.

Mr. Sawyer is so well known in the lighting industry that an introduction from us seems hardly necessary. Educated at Richmond County School, he spent a number of years in the Electrotechnics Department of the National Physical Laboratory, after which he took a three-year heavy electrical engineering course at the City and Guilds Engineering College at South Kensington. In 1929 he joined the lighting department of the British Thomson-Houston Co., Ltd., under H. C. Wheat. In 1932 he joined the staff of the ELMA Lighting Service Bureau, taking charge of the Bureau early in the war and being appointed Manager in 1946. Mr. Sawyer has

E. B. Sawyer
IES President
1957-58

served on the IES Council a number of times and was Honorary Treasurer for three years. He has served on a number of IES, BSI and NIC committees and is at present Honorary Treasurer of the NIC organisation. One of his hobbies is golf, at which he hopes one day to win the Dow Cup.

Mr. Sawyer takes office at a fortunate time. The IES has adopted its new constitution and the way is now clear for the Society to develop. Under Mr. Sawyer's lead we are sure the Society will start off in the right direction, and we wish him a happy and successful year cf office.

As we have said on previous occasions, the office of President becomes more onerous every year. The retiring President, Dr. W. E. Harper, has set a standard of activity which future Presidents may find difficult to attain. His attention has been given to all aspects of the Society's activities as all who have seen him in action at meetings of the Council and of committees know full well. His chairmanship and impartiality at meetings has been remarkable whilst his sense of proportion and of humour have helped to sort out many a difficult problem. He will shortly be leaving for a tour of Australia and India; we wish him a very successful trip.

Lectures on Architecture

About twelve months ago John Reid gave a very successful series of four lectures on architecture to members of the IES. So successful in fact were they that the IES has decided to put on a further series in November and in collaboration with the Science Committee of the RIBA the following programme has been arranged :—

- Nov. 7 A review of present architectural thought and trends, by H. T. Cadbury-Brown, FRIBA.
- Nov. 14 School design, by David Medd, ARIBA.
- Nov. 21 Modern planning trends in offices, buildings and factories, by John Bickerdike, ARIBA.
- Nov. 27 Planning the interior; the expression of current ideas and requirements, by Brian Westwood, FRIBA.

The original Reid lectures were put on at very short notice, but, nevertheless, obtained an average audience of about 70. By giving the present lectures more notice it is hoped that a larger audience will attend. The lectures are all to be given at the RIBA. Portland Place, so there is plenty of room. (Note that the first three lectures are on Thursdays and the last on a Wednesday.)

It was apparent from the Reid lectures that there was a great interest amongst lighting engineers for matters architectural and before the series was over the IES Education Committee was receiving requests to repeat or extend the series. Reid's lectures dealt mainly with the history of architecture; the present series is intended to deal with modern architecture and we shall be surprised if there is not a good turn out for all the four lectures.

Attendance at the lectures is not confined to IES members, neither are tickets required. It is hoped that readers will make these lectures known to their friends and colleagues.

IES Programme

The IES Programme for the 1957-58 session has just been issued. We note that the programme of London meetings is given only for the first half of the session, details of the second half to be given later. (This, we understand, is due to the IES Papers Committee's toughening-up policy of insisting on seeing the MSS of papers before putting them in the programme.)

The subjects so far announced for London are of interest and have not as far as we know appeared in the Society's Transactions before. The meeting on November 12 is original if only for the number of places which members and visitors will visit during the evening which begins with tea at the Victoria and Albert Museum, a tour of the electrical collection at the Science Museum and then in the theatre at the Science Museum the lecture by Rawson-Bottom and Harris on the lighting of museums and art galleries. The subjects for December and January (respectively TV lighting equipment by Ackerman and lighting of aircraft flight decks by Strange and Stevens) are certainly up to date.

Two departures from the normal programme are the inclusion in November of a series of four lectures on architecture (a special note on which you have already read) and a one-day conference on factory lighting to be held on April 1. Details of this conference will be announced later by the IES, but we understand that it is intended for factory engineers, not for lighting engineers.

Perhaps these lectures on architecture and the conference on factory lighting will give the IES Centres some ideas for broadening the scope of their meetings, for on the whole there is little originality about the provincial programmes. Widening the scope of its activities is a matter which the IES must begin to take very seriously. The Society cannot stand still; if it continues to churn out the same kind of material every year, shuffling its speakers (however willing and able) and lectures, its members and membership will soon reach saturation point—and then the architects will really take over lighting design and the engineers will be left only to supply the lamps and gear. Lamps and gear are, of course, important—the industry is constantly striving to improve them and the engineer has to keep up to date—but they are only means to an end. Even the lighting of buildings, things, and places is not the ultimate end; somewhere the people who use or see these things come into the scheme. We cannot tell the IES how to arrange its programme, but we do hope that those responsible for it will get down to some serious thinking.

Management of Design

The Council of Industrial Design has just published as a booklet entitled 'The Management of Design' a report on the International Design Congress which it held in London last September. The book is a digest of the views expressed by more than thirty principal speakers from this country and abroad on the title theme.

The conference discussed the practical implications of three cardinal principles: (a) An effective design policy involves giving responsibility to someone at or very near board level who has sufficient authority and belief in design to supervise the formulation and execution of that policy. (b) Designers must take their place in the industrial team on an equal footing with engineers, salesmen and other specialists. (c) Good design is indivisible and should extend to all activities of a firm, including its publicity material and auxiliary services. Copies of the book are available from the COID price 3s. 6d. (4s. by post).

C. & G. Examination Results

The results of the City and Guilds of London Institute examinations in illuminating engineering held earlier in the year have just been announced and are as follows:—

INTERMEDIATE GRADE

First Class—A. V. Chapman, J. L. Cooper, J. B. Davey, E. B. Dawson, P. S. Hayes, W. Smyth, D. Scott, W. Yeadon, J. S. Tomlinson, S. A. Lord.

Second Class—J. E. Baker, D. W. Collett, P. Hall, C. Richardson, A. M. Seggar, A. I. Simper, M. Boardman, R. E. Brown, P. J. Bull, W. R. Knight, A. G. McKenzie, A. C. Manwaring, C. F. Oliver, G. A. Spencer, A. Whitehead, J. A. Fenner, B. A. Shortt, P. A. Worthington, A. Wylie, A. J. Walder, R. Aspinall.

FINAL GRADE (PAPERS 1 AND 2)

First Class—N. J. Jenson, B. Morgan, K. H. W. Last, M. C. H. O. Shaw.

Second Class—M. F. M. Bowser, W. Burt, B. H. Cross, M. J. Hall, W. F. M. Langsworthy, R. J. Fothergill.

FINAL GRADE (PAPERS 1 AND 3)

First Class—B. Morgan, B. H. Cross, A. R. M. Spalding, B. Cassidy, G. W. Lawlor, M. A. Moloney, J. J. Toomey.

Second Class—A. V. Cale, G. D. Deacon, N. J. Jenson, M. F. M. Bowser, F. H. W. Brightwell, W. Burt, M. J. Hall, B. P. Kelly, D. J. Lyons, K. Moore, M. C. H. O. Shaw, J. C. Procter, R. A. Bullock, D. R. Singer, R. J. Fothergill, J. R. Barker.

INDUSTRIAL LIGHTING

Though this feature contains much information of value to architects and lighting engineers it is primarily intended for factory engineers and managers whose responsibility it is to see that their premises are properly lit and that their factories are working at maximum efficiency. Many factories are very well lit but there are far more where the managements either have not yet appreciated the value of good lighting or hesitate for various reasons to call on expert advice. In this feature no attempt is made to cover all aspects of industrial lighting. Much of the material in Mr. Stevens' article is well known to lighting engineers; much of it, however, will be new to the many factory executives who have so far given little more than passing thought to lighting. The typical installations on pages 294-314 deal with a wide range of lighting problems commonly met in industry and numerous examples of good lighting practice are shown. Factory executives will not find all the answers to their lighting problems in the following pages but it is hoped that their interest will be stimulated sufficiently to look critically at their own lighting and to seek further information.

Lighting for Industry, By W. R. Stevens, B.Sc., M.I.E.E., F.I.E.S.

IN these times when high productivity is vital it should not be necessary to give arguments in favour of good factory lighting: certainly the progressive and efficient managements now appreciate that a mere subsistence level of lighting is not good enough.

It is understandable that not everybody is convinced for our eyes make remarkably good use of poor conditions. Even in starlight we can see much, although the illumination is less than one millionth of what we are accustomed to on an ordinary day. Nevertheless, the consensus of informed opinion is strongly in favour of generous lighting, so that we find the Chief Inspector of Factories reporting a "realisation by the management and worker, many of whom have worked the best part of a lifetime under inferior conditions, of the importance of good lighting."

The arguments in favour of good lighting are twofold :—

(1) A direct improvement in efficiency of working;
(2) An improvement in working conditions.

There is much evidence to show the improvement in efficiency of working, both from experiment in the laboratory and from tests in factories. For example, it can be shown in the laboratory that most of the properties of the eye are improved as the illumination is increased. One of the most important properties of the eye is the ability to detect fine detail, and it has been shown in many well-controlled experiments that this ability is increased continuously as the illumination is raised to levels far beyond those which are commonly found, even in the best-lighted factories. There is, of course, a limit above which the return will often not pay for the increased cost of the lighting, but this is seldom reached, even to-day. It can be shown, too, that the ability to detect small differences in contrast and colour is improved as the illumination is increased. To take an obvious example, if it is required to use dark threads against a dark background, a very high level of illumination is useful, although this is not the only important factor. There have also been other researches which

Table 1

Productive value of lighting

Process	Illumination (lm/ft^2) Old system	New system	Increase in Production (per cent.)
Typesetting by hand	1.3	20	24
Foundry work	2.5	7	7.5
Tile pressing	0.6	6	10
Silk weaving	50	100	21
Lathe work	12	20	12
Post office sorting	3	6	20
Wire drawing	3	9	17
Roller bearing manufacture	5	20	12.5

show that the speed at which work can be performed is dependent upon the lighting in which the task is done, and in some of these experiments it has been evident that the number of errors made will fall substantially with good lighting as compared with poor.

Such experiments, made in the controlled conditions of the laboratory, provide a convincing basis on which to build our knowledge of desirable amounts of light. However, they are less impressive to the factory manager than experiments performed in working conditions, experiments performed indeed in factories on people doing their daily jobs. Table 1 gives a few results of such experiments.

In all of these it will be seen that a substantial increase in production has been obtained by increasing the illumination. The values listed under "old system" are for the most part rather low by present-day standards, and the new values adopted are not particularly high; even the 100 lm/ft^2 used in the silk-weaving trials is a frequently found value in modern industrial lighting installations. As an example of the value in terms of money resulting from these changed illuminations, it is worth noting that in the experiments on type-setting by hand the value of increased output was some 34 per cent. of the payroll, whereas the cost of the increased lighting was only 2½ per cent. Incidentally, errors were reduced to less than half in these trials.

Thus we see there is useful evidence showing that better lighting is often worth much more than it costs. This may not seem surprising when we are dealing with tasks which depend critically on the eyes, as, for example, type-setting by hand: but there are other forms of work in which visual or even manual dexterity is not particularly important. One of these is tile pressing, and the experiment referred to in Table 1 was particularly concerned to see whether with such a task, which makes only simple visual demands, there could be a justification for better lighting. In fact, the answer appears to be, yes. This suggests that the value of light as an amenity in brightening the place and making working conditions more pleasant seems to be high. It is interesting that in one very important tile-pressing factory in the Midlands an illumination level of 15 lm/ft^2 is now used in a well-designed installation of tubular fluorescent lamps.

Evidently there are factory managements who do not need convincing that working conditions should be as pleasant as the job permits, and that our daily work is not to be regarded as a necessary evil to be made as dreary as possible, so that by contrast our leisure may be the more attractive. It is an important fact that in the United States, where productive efficiency is high, the standards of lighting in industry are higher than in Great Britain and, indeed, probably higher than in any other country in the world.

Having satisfied ourselves that care should be taken with the lighting and that money should be spent on it, we must now determine the method of lighting and examine the tools available. During the last half-century lighting, like other technologies, has moved from the age of the train to that of the aeroplane. New lamps, new materials and new methods have made it possible to light any industrial situation effectively. As an example of the diversity of equipment available to the lighting engineer, Table 2 shows the more important lamps commonly used in industrial lighting.

This represents more than 50 different types or wattage ratings of lamps, excluding the several different colours available in tubular fluorescent lamps and the multiplicity of voltage ratings still necessary in Great Britain. Some of these lamps are small and of high brightness, some are large and of low brightness. There is a

Table 2

Commonly used electric lamps

	Colour	Wattage Range	Life (hours)	Costs when used in interiors: Initial	Running
General lighting service (incandescent tungsten)	White	15 to 1,500	1,000	Low-medium	High
Tubular fluorescent	Several shades of white	15 to 125	At least 5,000	Medium-high	Low-medium
Mercury	Greenish	80 to 1,000	4,000	Low-medium	Low-medium
Mercury colour corrected	Near white	80 to 1,000	4,000	Low-medium	High
Dual lamps (combined mercury and incandescent)	Near white	160 to 250	3,000	Medium	High
Cold cathode fluorescent	Several shades of white	Almost any; made to measure	At least 15,000	Very high	Medium
Sodium	Yellow	45 to 140	4,000	Very seldom used inside	

great variety of colours, the tubular fluorescent lamps having many shades of "white" within their own range. Some of the lamps are cheap to install, but relatively expensive to operate: in others a high installation cost is more than offset by low running costs for many applications. The most widely used of the lamps are the general lighting service (tungsten filament) and the tubular fluorescent, which has had a phenomenal climb to popularity in the last 15 years. Sodium lamps are very efficient, but their poor colour rendering makes them in general suitable only for outdoor use. The colour corrected high pressure mercury discharge may give us the lamp of the future.

This range of light sources is useful because of the great variety of industrial situations. Most of us are apt to think of a few types of industry to the exclusion of all others but in fact, of course, the rangeis fantastic. The lighting engineer will be concerned on one day with a works making or assembling heavy engineering equipment and on the next with the fabrication of small components, for example, for radio and television. There are places where fine silks are woven—others making barbed wire. Some interiors must be kept warm and dry and some are running with water. In places concerned with pharmacy or food preparation, the cleanliness must be impeccable. In chemical works, corrosion is an inevitable and constant trouble. Many factory interiors are 50 or 100 ft. high, many are less than 10 ft. Some cover vast areas, others house only two or three people in a room. Some types of work are (often wrongly) deemed impossible except by daylight, but there are interiors from which the daylight is completely excluded. We must remember, too, the many parts of a works which are ancillary to the premises in which manufacture itself is done. Storage, packing and dispatch bays, offices—both for design and general clerical work—canteens, rest rooms, are all essential, and the whole works will stand in grounds including service roads and factory yards, which need lighting. The same problem is seldom repeated exactly from works to works.

Now light can be provided very simply in all these many different places: indeed, all that is required to turn darkness into a region in which some work can be performed are a few bare lamps hanging on a few pieces of wire, just as a hurricane lamp or a torch makes it possible to search the garden to find the source of an unexplained noise: and the factory manager who has not seen, or will not see, anything better, will probably be satisfied with a few bare lamps. In the same way, a runner was once satisfied to cover a mile in four minutes 30 seconds. Nowadays, we are not excited unless a time under four minutes is achieved, and we are even assured that for the next Olympic Games it will be necessary to do this simply to qualify for the final stages of the competition.

The Illuminating Engineering Society has formulated a Code of Practice which recommends desirable illumination values for different types of work. This Code is based on experiment and experience, and it takes into account also the economics of lighting. Its recommendations are not the wildly optimistic desires of theoreticians, nor those minimum values which are the first step from nothing; the values given aim at being a wise compromise.

Selection of the appropriate quantity of light is, however, only the beginning to planning an industrial lighting installation, for next, and in many ways more important, the lighting must be properly engineered. This is not a task for the amateur however much he may pose as an expert in the cloak of some other profession, and however easy it may seem to be. It is a job requiring skill and experience. From the visual requirements of the workers must be deduced the type of lighting: for example, shall it be strongly directional or diffuse; should the light sources be compact or extended; should the equipment be mounted high or low; will general lighting suffice or should there be additional local lighting; is the colour a matter of prime importance; what are the facilities for maintenance?

From such considerations we decide the type of lamp, its colour and wattage and the type and arrangement of the light controlling equipment. This may be specular or diffuse, compact or extended: it may be in the form of isolated units, continuous rows perhaps mounted on a trunking carrying other electrical services, or built into the structure of the building. The disposition of the equipment relative to the work being done is obviously of prime importance. The more accurately the layout of machinery on the factory floor can be specified, the more accurately can the lighting be designed. It is with considerations of this kind that most of the examples which follow this article are concerned.

Maintenance, of course, is one of the main costs of an installation, and it is a cost which is rarely assessed properly. It is not at all uncommon to find that the labour charges for replacing a lamp are several times as great as the cost of the lamp itself. This explains why, perhaps unexpectedly, high voltage cold cathode discharge lamps are often installed, although their initial cost may be nearly 10 times as much as some other forms of lighting. Because of their very long life it is seldom necessary to change a lamp and some managements are satisfied that in the long run these lamps save money. This is particularly true in a factory operating for 24 hours a day. It is essential in calculating the cost of an installation to allow not only for the obvious factors such as the cost of the lamps and equipment and the cost of the electrical energy, but to remember also that the number of hours of use per day and the rate at which the capital cost is to be written off have an important effect on the calculation. It is important, too, to provide proper facilities for cleaning and lamp replacement and to attempt some sensible estimate of what these will cost.

Because there are so many variables which complicate the calculation, no actual figures of costs have been included in Table 2, but only a rough indication of the initial and running costs. In the column headed "initial cost" the ratio implied by terms "low, medium, high and very high" is roughly 1, 2, 3, and 4, with the cheapest reasonably good installation costing of the order of 6d. per square foot for the fittings and lamps. In the column headed "running costs" the range is about 2:1. With electrical energy at 1d. per unit, the cost per 1,000 hours of the cheapest decent installation will be roughly £6 per 1,000 sq. ft. This, however, does not include amortisation of initial cost, nor does it include the cost of wiring and labour for the installation or the cost of maintenance during the life of the installation.

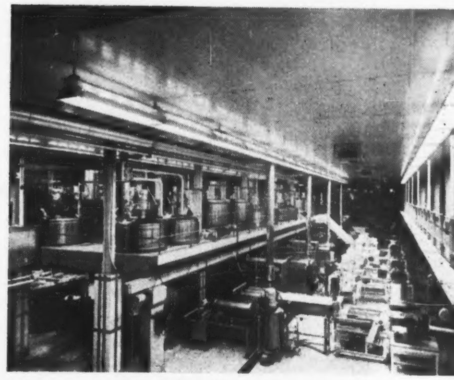
Even so, these values are small compared with overall costs of equipping and operating a works and yet the rewards for the good lighting may be high. Although the works manager must take care of every small expenditure, he must also ask himself, "What will I lose by parsimony? Can I afford not to have proper lighting?"

INDUSTRIAL LIGHTING

TYPICAL INSTALLATIONS

To show lighting installations typical of even the major industries would take up more space than could be given in one issue of the journal. In a survey such as this it is not, however, necessary to deal with all industries as many, though concerned with different products, have similar lighting problems. The installations in the following pages have therefore been grouped according to types of lighting problems, problems which may be imposed by the kind of product and/or by the kind of premises. With each group the basic problems are stated, possible solutions are discussed and a number of pictorial examples are given; in each group the text and illustrations are complementary and should be considered together. By treating the subject in this way the majority of lighting problems met in industry are dealt with even though a particular industry may not be mentioned.

A high-bay installation (see section 5). The oil-filled cable section of the Woolwich works of Siemens Bros. & Co. Ltd., is 186 ft. x 80 ft. in area, with a ceiling height of 43 ft. An illumination level of 7 lm/ft^2 was required so that gauges could be read and controls operated. Low initial costs, running costs and maintenance costs were asked for. Colour was not of great importance, though it was stressed that the colour should not be such as to make working conditions unpleasant. The lighting is provided by 21 400-watt m.v. lamps in vitreous-enamelled reflectors designed to use convection currents to keep the reflector surface clean. Under the mezzanine floor 125 lamps are used in ordinary vitreous enamelled dispersive reflectors. (Siemens Edison Swan Ltd.)



Above, at the "Stork" margarine factory, Purfleet, Essex, in order to provide a dust-free atmosphere, a false ceiling has been installed. Continuous trunking is suspended through the ceiling to support continuous rows of fluorescent fittings with "Perspex" visors, giving an illumination level of about 20 lm/ft^2. (Wm. Steward and Co. Ltd.; G.E.C. trunking.) Left, at the Westbury, Wiltshire, cheese factory of Aplin and Barrett, Ltd., a luminous ceiling was suspended below the barrel-vaulted true ceiling. This reduced the volume to be heated; facilitated the maintenance of a high standard of cleanliness; improved the thermal insulation and provided a high level of even, glare-free illumination. The ceiling is of corrugated vinyl sheeting; the light source consists of rows of twin 5-ft. 80-watt fluorescent lamps. (Lumenated Ceilings Ltd.)

1 Food, pharmaceutical and cosmetics factories and laboratories

THE PROBLEMS

Colour rendering and matching; location and enclosure of light sources to avoid danger of foreign bodies falling into materials being processed; easy access for maintenance; dangerous atmospheres (sometimes).

THE SOLUTIONS

WHERE colour matching is important colour - matching fluorescent lamps should be used in sufficient quantity to give high levels of illumination. In industries such as the cosmetic and dyeing trade, where accurate colour matching is of absolute importance, a composite source of tungsten, blue fluorescent and long-wave ultra-violet gives lighting most closely approximating to north-sky daylight.

Whichever system is chosen, standard colour samples should be used to check the production run, and they should be checked periodically against a master standard to ensure that the ageing of the lamps is not producing any change in their colour-matching properties.

Where it is necessary to mount fittings over material being processed, unbreakable material should be used to enclose the light source to prevent contamination if a lamp breaks. The obvious choice is "Perspex." It must be remembered, however, that an enclosed fitting will cause the lamp to operate at a higher temperature, and care must be taken to ensure that there is sufficient ventilation to prevent premature lamp failure.

Adequate illumination on the working area can often be achieved by using angle-type fittings which are not mounted directly over the material being processed. This arrangement, because it eliminates the danger of contamination, allows standard fittings to be used and renders them more accessible for maintenance.

If dangerous, but not explosive, atmospheres are present, it is best to provide light over the working area by means of a luminous ceiling or by panels in the roof or ceiling glazed with "Perspex" or similar material, with standard lighting equipment mounted above. If the atmosphere is inflammable, there is no alternative to the use of flameproof equipment.

2 Outside areas—traffic routes and working areas

THE PROBLEMS

Lighting regular 'traffic' routes; revealing obstacles in 'parking' areas for materials and other bulky articles to which occasional access is necessary; floodlighting for outdoor working areas in immediate vicinity.

THE SOLUTIONS

IN general, the same principles apply to works roads as to normal traffic routes—i.e., a uniform road brightness against which obstructions are seen as silhouettes. Roads within a works that are in regular use should usually be treated as Group A roads, with lanterns mounted on 25 ft. columns and having an output of some 3,000 lumens per 100 ft. linear. Good colour rendering is seldom an important consideration, and sodium-vapour lamps, because of their high efficiency, are usually most suitable.

The relative importance of the various roads within a works may sometimes be indicated by using different light sources—e.g., sodium and mercury—but, in order to standardise, it may be preferable to use adequately lit road signs for this purpose. If Group B lighting is used on less important roads, care should be taken to avoid "overhang," otherwise lanterns mounted at 15 ft. may be hit by passing lorries.

To light a large working area economically, the number of poles or towers should be minimised, and as many of the lighting fittings as possible should be fixed to the buildings in the vicinity. Equipment should be chosen, therefore, that will spread the available light over the widest possible area.

This outdoor storage area in the open slab yard of The Steel Company of Wales Ltd., Abbey Works, Port Talbot, is lit by 1,000-watt MB/U lamps at a mounting height of 57 ft. 6 in. They are spaced at an average of 30 ft. centres. (Philips Electrical Ltd.)

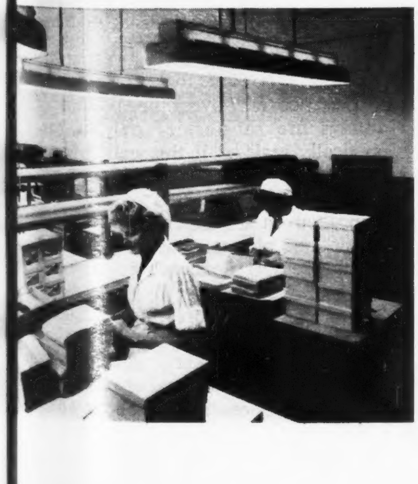
Above, lighting of an outdoor area at Wallsend-on-Tyne docks to facilitate the cleaning out of the tanks of oil tankers moored alongside. The fittings are mounted on "Brevis" concrete columns, those within 50 ft. of the tanks being of flameproof design. (General Electric Co. Ltd.) Right, car park at the Aldenham bus repair depot of the London Transport Executive, lit mainly by 1,000-watt "Duoflux" reflector fittings mounted at 30 ft. above ground level on double-headed standards. (Benjamin Electric Ltd.)

3 Stores, packing, dispatching

THE PROBLEMS

Getting light into bins; adequate illumination for reading requisitions and keeping records; prevention of troublesome and dangerous shadows cast by stacked goods, etc.; adequate illumination in loading area.

Below, packing bars of Fry's confectionery at the firm's Somerdale factory. The trough fittings, which house 5-ft. fluorescent lamps, have easily removed one-piece reflectors to minimise corrosion and facilitate cleaning. They are stove enamelled and have slots to allow an upward component of light. (General Electric Co. Ltd.)



THE SOLUTIONS

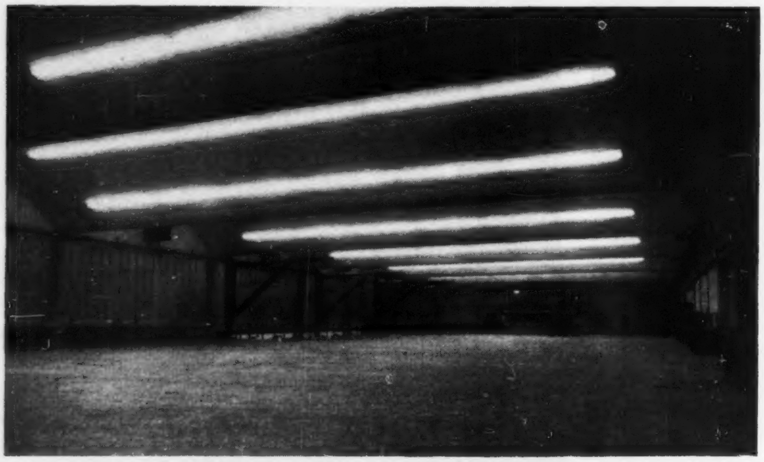
WHILE it is usual to use fluorescent fittings mounted parallel with the gangways between stock bins, it is often better to orient the units at right angles to the bins. In this way the edges of the shelves do not cast such heavy shadows, and light penetrates further into the lower shelves. The simple expedient of painting the interior of the bins a light colour is often neglected, although this can contribute considerably to the light at the back of the bins.

Where bins are used only occasionally, it is often not economical to use fluorescent equipment. Tungsten lamps, however, may cause glare and fittings should be chosen that give most of their light directly into the bins, giving only diffused light along the gangway. Prismatic bulkhead fittings can often serve this purpose well.

Where goods are stacked high in large stores or warehouses, good general lighting should be provided. A staggered layout, with lines of fittings running diagonally across the rows of goods, will usually ensure that the gangways between stacks are reasonably shadow-free. To prevent the lighting equipment from being damaged, it is advisable to mount the units so that they do not hang below the roof trusses.

Store lighting calls only for an illumination level of 7 lm/ft^2. If the area is large and high a small number of high-wattage lamps may be used, but it is usually better to have a larger number of low-wattage lamps. If there is a danger of heavy shadows being cast by stacked goods, this latter arrangement assists those who must read requisitions and keep records.

Stores, packing, dispatching *(continued)*



The lighting of loading areas must be arranged so that light shines into the vehicles being loaded. Fittings should be carefully arranged on either side of the loading position or parallel to the backs of the vehicles. Fluorescent lamps are more suitable than tungsten, as they are less likely to be obscured by the loaders.

If a store is equipped with a travelling crane, lighting fittings (suitably protected from mechanical shock and vibration) should be mounted beneath it to compensate for the light it hides.

Above left, stores at British Railways Kings Cross Goods depot lit by continuous rows of "Ionlite" cold-cathode fluorescent fittings surface mounted to the barrel-vaulted shell concrete roof. (Falk, Stadelmann & Co. Ltd.) Left, stockroom and forwarding department of Walpamur paint factory. Good general lighting is provided by rows of trough fittings with vitreous enamelled reflectors housing 5-ft. 80-watt fluorescent lamps arranged to coincide with the gangways and, thus, to obviate shadows from the piles of stock. The mounting height is 12 ft.; the illumination level 12 lm/ft.^{2} (Revo Electric Co. Ltd.)

4 Adverse atmospheres

THE PROBLEMS

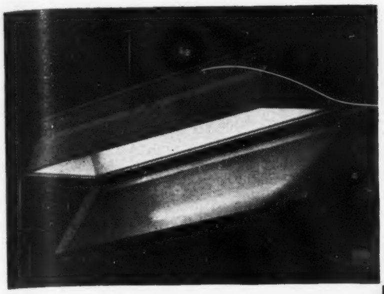
Selection or design of suitable luminaires, e.g., dustproof, flameproof, etc.; location of luminaires; provision for maintenance.

THE SOLUTIONS

FOR dirty atmospheres use can be made of "through-draught" fittings, in which a current of hot air produced by the lamp carries dirt through and out of the fitting. Alternatively, fittings with reflectors of stainless steel or super-purity aluminium may be used. Fluorescent fittings should have detachable reflectors; tungsten fittings should incorporate a bayonet fixing for the reflector, which should be readily detachable from the suspension to facilitate frequent maintenance.

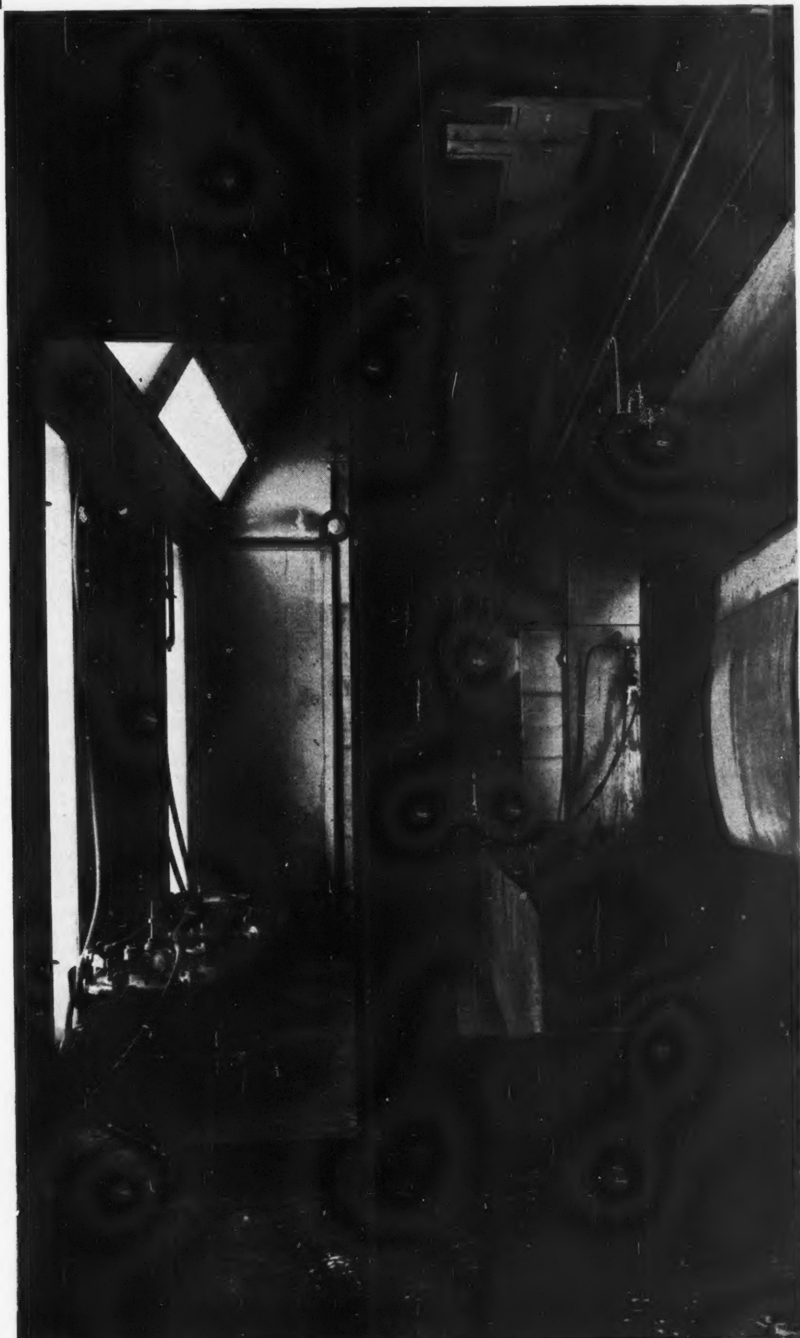
Dust covers over the bottom of fittings are satisfactory only if hermetically sealed. If the sealing is not perfect, the fitting "breathes" when switched off. Dirt drawn into it is deposited on the inner surface of the cover and obscures more light than would be lost if the cover were not there.

For damp or corrosive situations, luminaires should be constructed of plastic, porcelain, glass, good quality vitreous-enamelled metal or one of the special corrosion-resistant alloys which

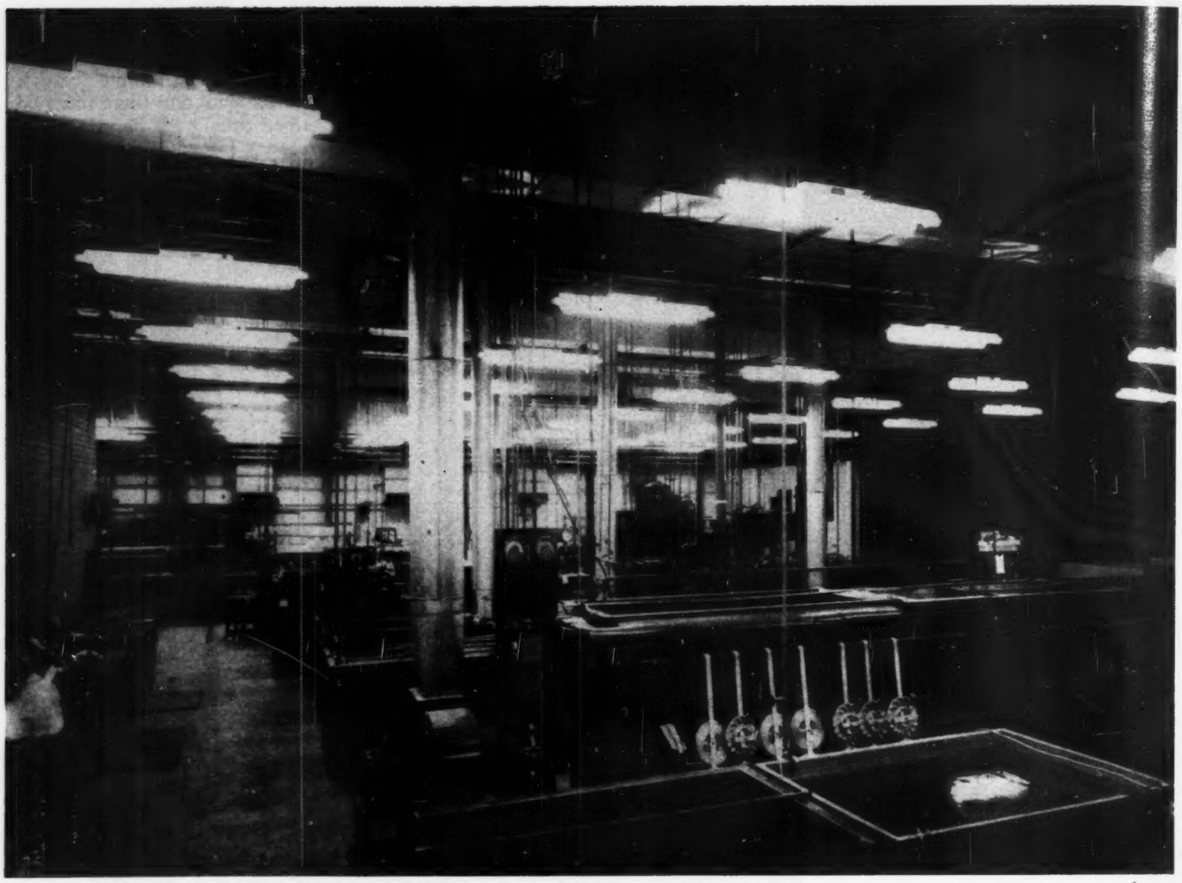


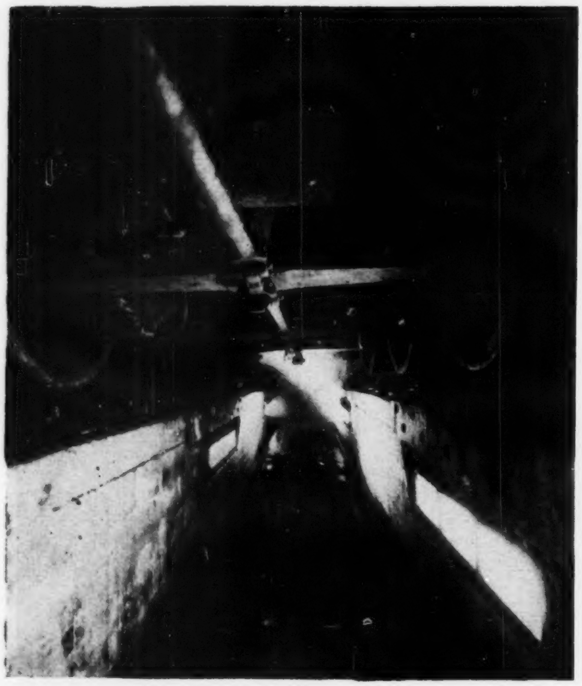
have been developed specially for this application. All joints between components should be gasketed, and frequent maintenance should be given.

Luminaires which are to be used in inflammable or explosive situations must comply with BSS 889. This specification lays down stringent details of manufacture, the main points of which are that electrical connections both from the mains to the unit and from the lampholder to the lamp must be made in separate enclosed compartments. Any joints in the metal work must be machined, and there must be a prescribed minimum gap between the surfaces when the unit is assembled. The unit must undergo an explosion test at the Ministry of Power Mines Testing Station at Buxton



Right, to comply with the necessary safety precautions, the fittings lighting this spray-painting booth (one of six) had to be placed outside the booth and arranged to illuminate the working area through suitably sealed wired-glass ports. Two fittings, each housing two 80-watt fluorescent lamps, were mounted vertically in the wall to the side and rear of the operative, and another two fittings each housing two 40-watt lamps were arranged horizontally above these on a sloping face. This arrangement minimised obstruction of light by the operatives. Above, a close-up of one of the fittings showing how, for maintenance, it can be swung away from the glass port. (Benjamin Electric Ltd.)



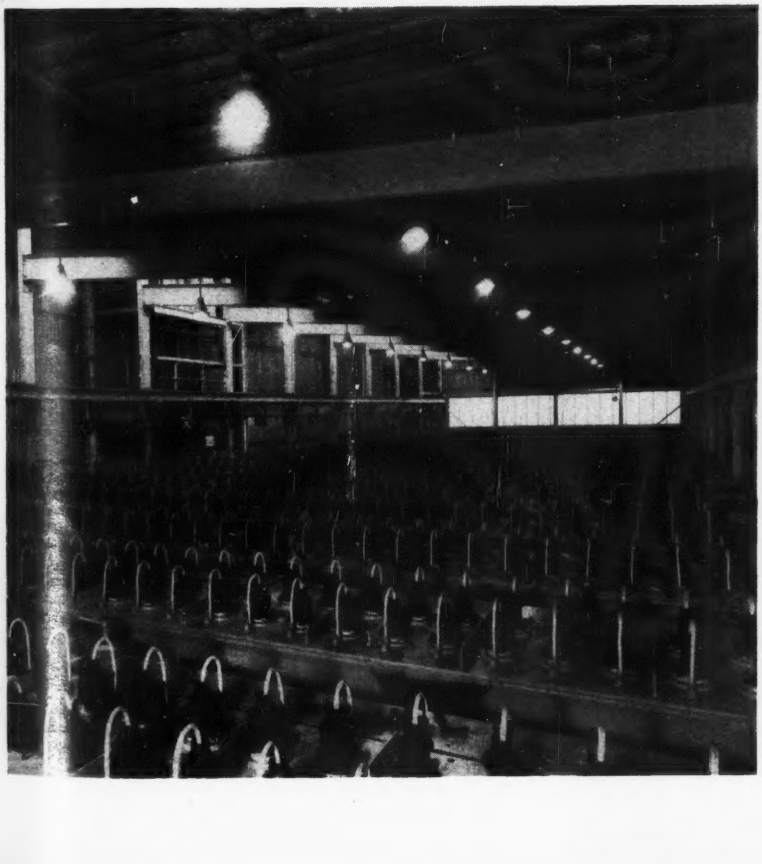


Adverse atmospheres *(continued)*

Above, lighting in plating shop at the Bristol Aeroplane Co. Ltd., Filton. Vapour-proof fittings housing 5-ft. 80-watt fluorescent lamps are mounted at truss level. Transluscent plastic reflectors are corrosion-resistant and allow upward component of light. The illumination level is 15 lm/ft^2. (Crompton Parkinson Ltd.) Left, railway engine maintenance pit. A fitting was required that could be mounted in the pit wall, would give upward light and would be resistant to oil, water, dust and heavy blows from maintenance equipment. Seen in the close-up below, the specially designed fitting houses a 5-ft. 80-watt fluorescent lamp. (Falk, Stadelmann & Co. Ltd.)

Right, part of the Beeston works of Boots Pure Drug Co. Ltd., where the drug Cortisone is made. Several highly inflammable solvents are used in the process and the complete building is designated as a hazardous area. In addition, the processing methods require fine adjustment and constant attention, and good lighting is needed to ensure easy and accurate control. Much of the machinery is massive and the feed lines of the various services are obstructions to both natural and artificial light. Flameproof fittings with prismatic covers were used, the units having a sharp cut-off and low surface luminance. Housing 300-watt lamps, they were suspended from roof trusses at 22 ft. 6 in. above floor level and spaced at 10 ft. x 12 ft. 6 in. centres. The illumination level in the open area is 18-20 lm/ft^2 (at 3 ft. 6 in. above floor level) and is approximately the same on the top platform levels, in spite of their being nearer the fittings. Areas beneath the platforms are lit by flameproof prismatic bulkhead fittings giving a nominal illumination level of 8-10 lm/ft^2. (Holophane Ltd.)

Below, lighting in the battery room of Murgatroyds Salt and Chemical Co. Good general lighting was required and it was essential that totally-enclosed corrosion-resistant fittings should be used. The fitting chosen houses a 300-watt g.l.s. lamp and was specially designed for wide spacing. (Falk, Stadelmann & Co. Ltd.)



Below, close-up of totally enclosed fitting used in the installation shown left.

For the high-bay area of the Aldenham bus maintenance depot of the London Transport Executive, a scheme economical in installation and running costs was required. For the light source, a combination of h.p.m.v. and tungsten lamps was chosen. The former are housed in fittings with standard vitreous enamelled reflectors, giving wide distribution; the latter are housed in aluminium concentrating fittings specially designed for use with 1,000-watt g.l.s. lamps. The illumination level is approximately 8 lm/ft^2 and maintenance is carried out from a mobile crane. (Falk, Stadelmann & Co. Ltd.)

5 High bays

THE PROBLEMS

Choice of suitable luminaires of necessary light output and distribution; access for maintenance; atmospheric absorption; avoidance of troublesome shadows; choice of light source.

THE SOLUTIONS

HIGH-BAY areas, by their nature, usually require lighting by units which project light downwards on to the working plane, and throw little light on to the walls and ceiling, as these surfaces cannot give much reflected light. If the area contains large high objects, the downward light from high-mounted overhead fittings may leave the sides of these objects in shadow, and supplementary lighting should be provided from the *sides* of the building to prevent this. Fittings for high bays should be designed to minimise maintenance, and the through-draught type of fitting is useful in these areas. Alternatively, fittings should have clear glass covers to facilitate cleaning.

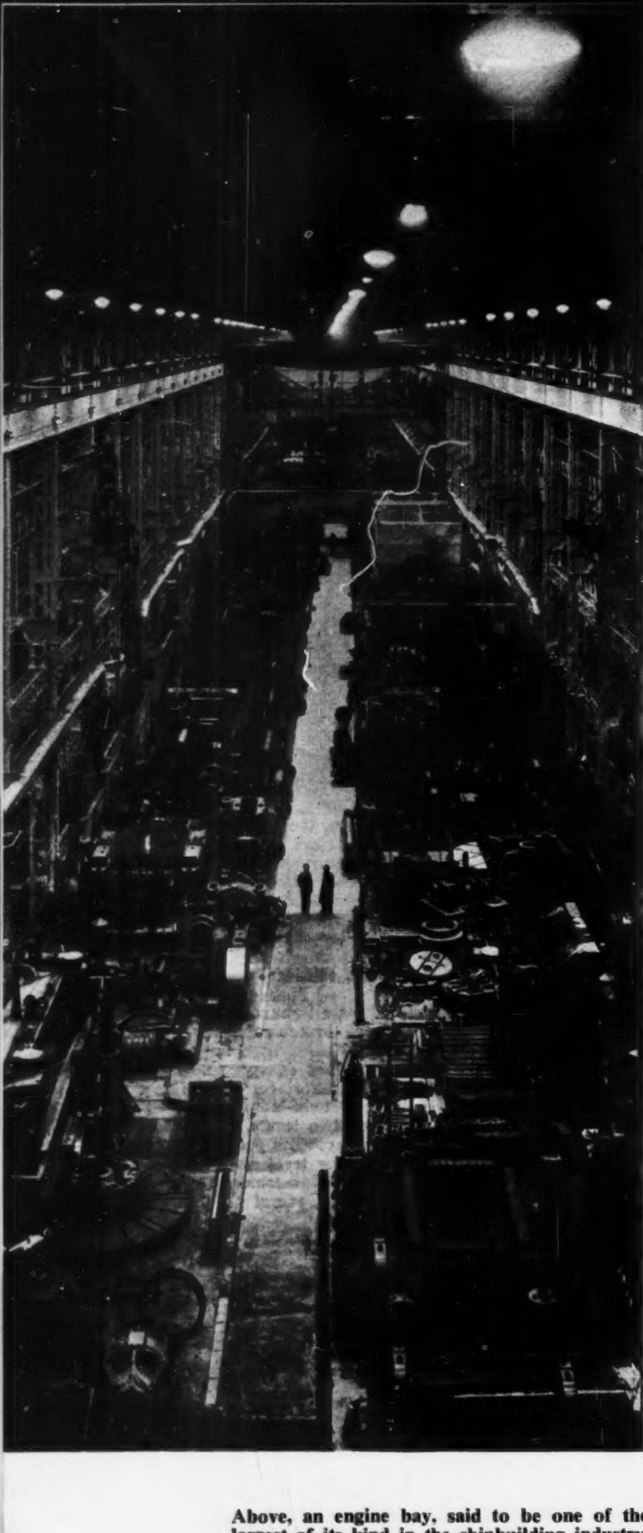
Because of the relative inaccessibility of the fittings, it is wise to use lamps which have a long economic life. High-wattage mercury vapour lamps have obvious advantages, having a life of 4,000 hours, though their colour rendering is not very good. However,

Above, the main erection and test bay at the new heavy engineering works, Witton. Lighting is from 48 1,000-watt h.p.m.v. lamps supplemented by a continuous row of fittings housing fluorescent lamps along the side and end walls. (General Electric Co. Ltd.) Below, the fully automatic foundry of Platts (Barton) Ltd. The main lighting problem was that of overcoming the obstruction caused by a large amount of overhead equipment. Lighting is by fluorescent lamps in single- and twin-lamp fittings arranged at two levels. The upper level provides general lighting; the lower level gives localised high intensities where required. (General Electric Co. Ltd.)

High bays *(continued)*

there is now available a colour-corrected mercury lamp, in which a coating of fluorescent powder on the inside of the glass envelope adds some red light.

In aircraft hangars, and wherever accurate colour rendering is required—where, for example, multi-coloured cables must be identified—neither tungsten nor mercury, nor even colour-corrected mercury, are suitable. Hot- or cold-cathode fittings are more satisfactory for this type of work : not



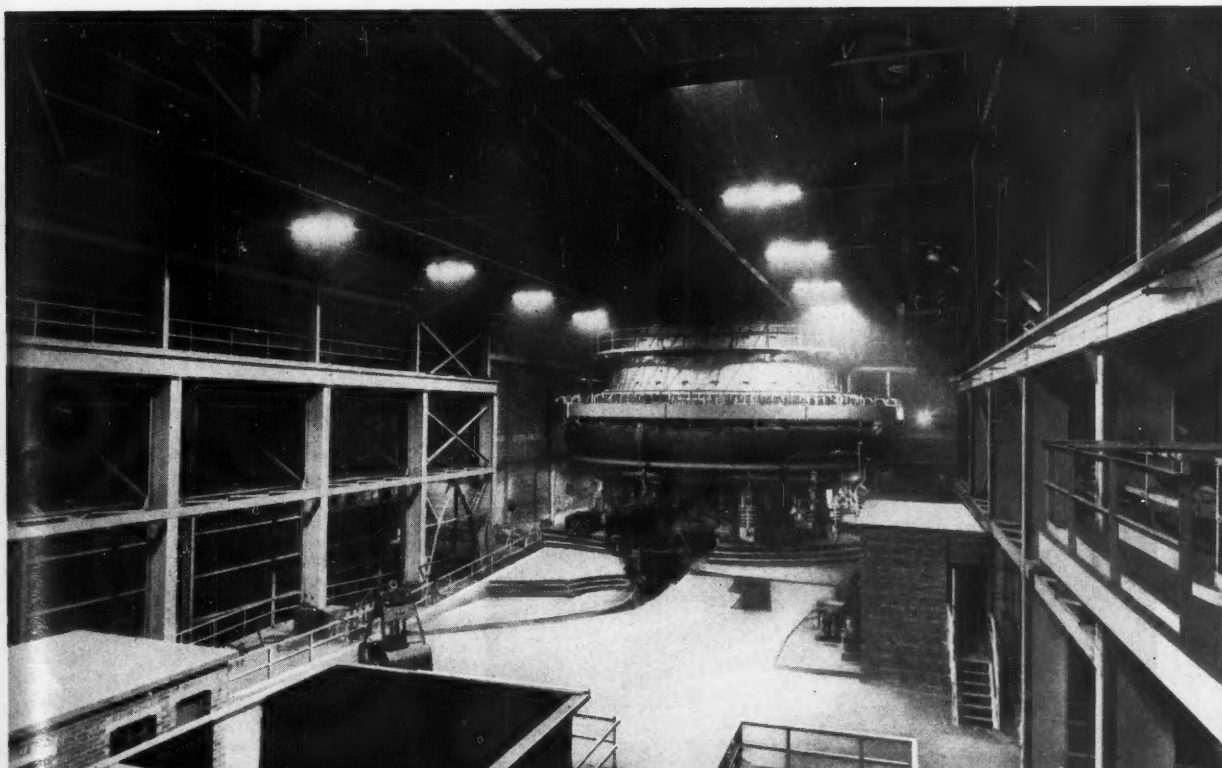
Above, an engine bay, said to be one of the largest of its kind in the shipbuilding industry. Lighting is by incandescent lamps, the three-row installation consisting of totally enclosed high-bay reflectors housing 1,500-watt lamps. Mounted at a height of 74 ft., they can be serviced from the travelling gantry. The illumination level is approximately 12 lm/ft^2 and there is a high degree of uniformity with good light penetration among the machines. (Benjamin Electric Ltd.)

Below, this foundry at the Glasgow works of Stewarts and Lloyds Ltd., has an area of over 100,000 sq. ft. It is lit by 1,000-watt m.v. lamps in heavy-duty fittings with prismatic reflectors, at a mounting height of 42 ft. The fittings are mounted on brackets attached to the sides of the cat-walks from which they are maintained. (Holophane Ltd.) Bottom, an illumination level of approximately 50 lm/ft^2 is provided in this workshop of Euclid (Great Britain) Ltd., by rows of 400-watt colour-corrected m.v. lamps mounted at a height of 33 ft. (General Electric Co. Ltd.)

only do they give better colour rendering, but the surface brightness is lower —a factor of some importance in aircraft factories where, because they often work *under* the planes, the men frequently look upwards towards the light sources.

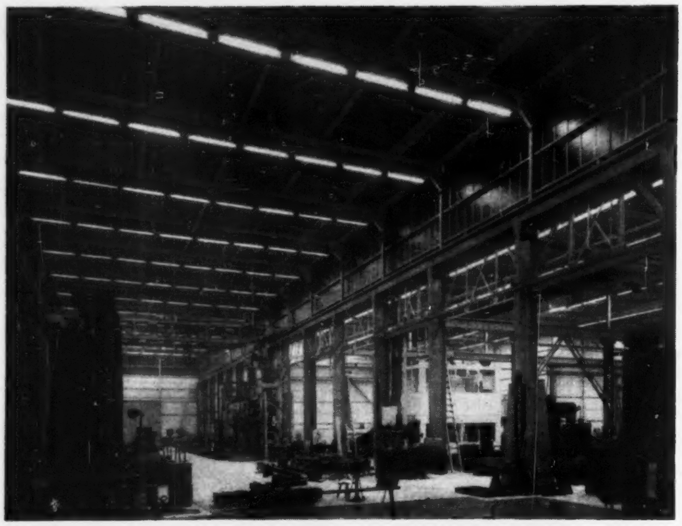
Where industrial haze or steam is present lamps of higher light output must be provided to allow for the reduced atmospheric transmission. In this connection, discharge lamps, either mercury or sodium, appear to have a greater penetration than tungsten.

Right, this high bay of a steelworks is 920 ft. long and over 100 ft. wide. Arranged in two rows are groups of fittings each comprising one 1,000-watt tungsten lamp and two 400-watt m.v. lamps in totally enclosed reflectors. The mounting height is 63 ft.; the illumination level about 8 lm/ft^2. (Benjamin Electric Ltd.) Below, another blended-light installation in a steelworks, using one 1,000-watt tungsten lamp to two 400-watt m.v. lamps. The mounting height is 40 ft.; the illumination level on the floor is 15 lm/ft^2. (Wardle Engineering Co. Ltd.)

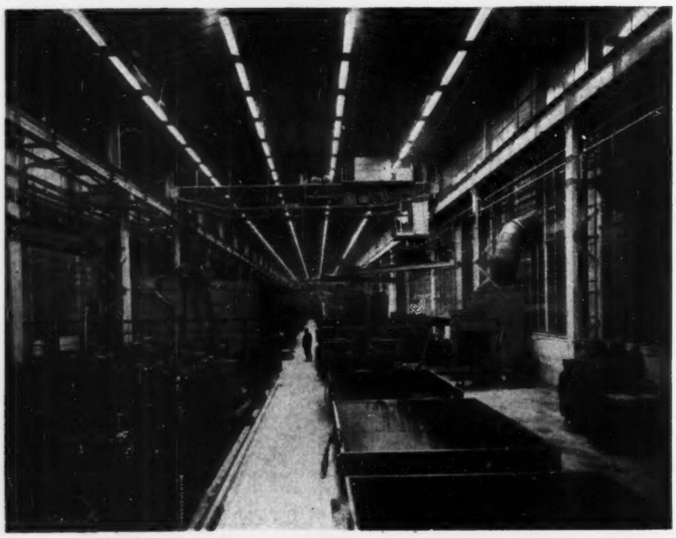


High bays *(continued)*

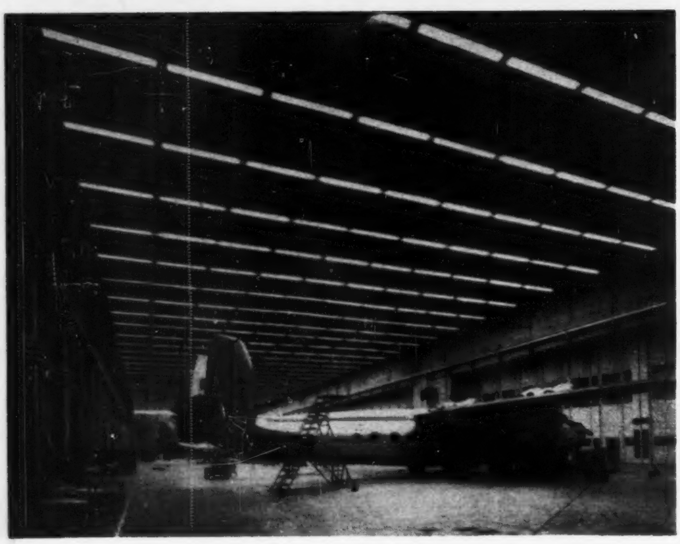
The maintenance of high-mounted fittings is best carried out from catwalks installed specifically for the purpose, though they can often be used also for the maintenance of other services. Girder cranes are sometimes used for lighting maintenance, provided the crane can be used for this purpose without interfering with its normal function.



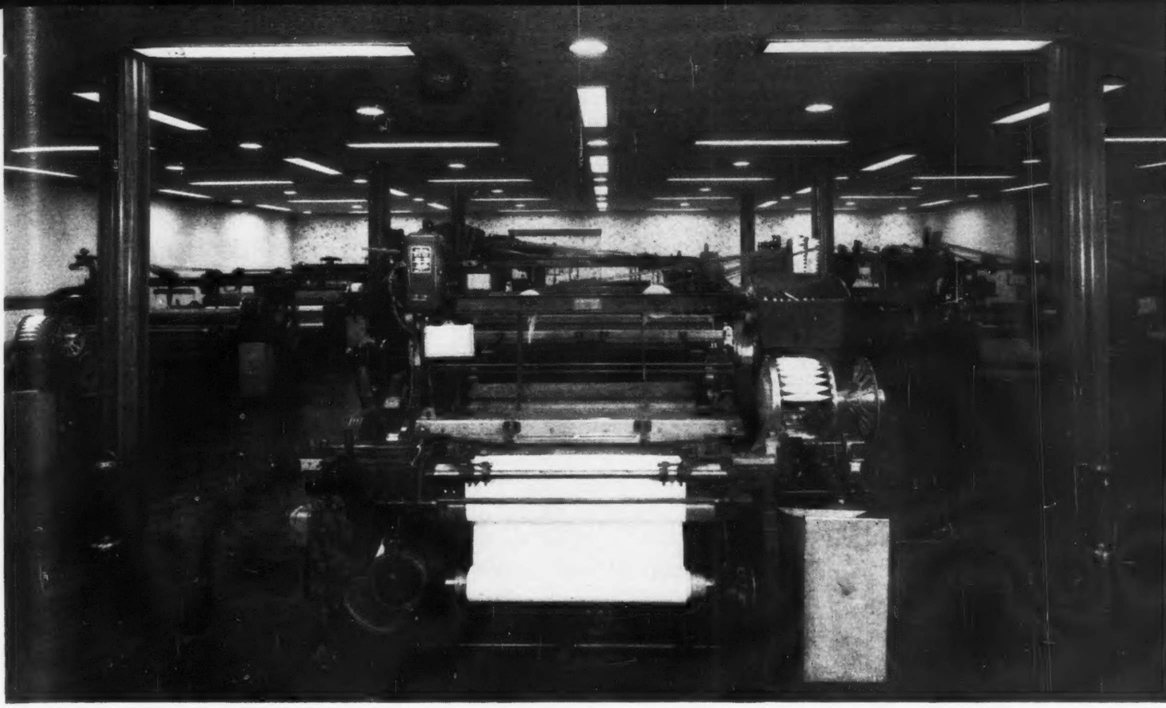
Top left, high-bay installation at Loewy Engineering Co. Ltd. comprising rows of fluorescent fittings fixed to the underside of castellated steel joists. (Ekco-Ensign Electric Ltd.)



Left, the Met-Vic transformer factory at Wythenshawe. Twin 8 ft. 125-watt fluorescent lamps, mounted in four rows at between 40 and 45 ft., were used to reduce maintenance costs. Illumination 3 ft. above the floor is 18 lm/ft^2.
Below, B.O.A.C. workshop at London Airport lit by five rows of cold cathode lamp fittings mounted at a maximum height of 44 ft. (General Electric Co. Ltd.)



Left, B.E.A. maintenance hangar, London Airport, used for maintenance of Elizabethan class aircraft. Continuous runs of "Ionlite" cold-cathode fittings are arranged in conjunction with the architectural features of the building. The long-line source minimises specular reflections from the metal surfaces of the aircraft and virtually eliminates shadows beneath them.
(Falk, Stadelmann & Co. Ltd.)



Above, weaving "shed" of the British Northrop Loom Co. Ltd. Fluorescent and tungsten fittings are recessed into the low suspended ceiling of acoustic tiles. (Troughton & Young Ltd.)

6 Low ceilings

THE PROBLEMS

Avoidance of direct glare and uneven lighting; limitation of radiant heat.

THE SOLUTIONS

IN areas where a reasonable mounting height is available the total illumination level depends partly on the small contributions of light received at a given point from distant fittings. Where ceilings are low, however (e.g., in converted buildings or in buildings where accurate temperature control would make tall ceilings unduly expensive), distant fittings are apt to be distracting. There is, therefore, a growing tendency to use in these areas fittings which project most of their light downwards, giving very little light sideways. On the other hand, it is most important in rooms with low ceilings to ensure that some light is directed towards the ceiling, otherwise a tunnel effect will be created.

Tungsten lamps have a high output of radiant heat, which is distributed by the fitting in the same way as the light. Hence, if fittings housing tungsten lamps are mounted near the heads of workers, severe discomfort will be caused, and in low-ceilinged areas fluorescent lamps have the advantage that the radiant heat they emit is only about half that from tungsten lamps and is spread over a larger area.

Left, lighting under cat-walk in machine room of newspaper printing works. Fluorescent fittings housing 5-ft. 80-watt lamps are arranged at an angle to throw light on the controls of ink and paper feeds. (Crompton Parkinson Ltd.) Right, good general lighting, without glare, in spite of the low mounting height is provided in this brewery cellar by bulkhead fittings with prismatic glass covers. The fittings give wide lateral distribution—a substantial proportion of the light being directed on to the walls and ceiling. (Holophane Ltd.)

Left, typewriter assembly at a Leicester factory. Open-top metal reflectors housing 5-ft. 80-watt lamps give good penetration, soft shadows and minimise glare from polished parts. (Crompton Parkinson Ltd.)

Above, lighting for relay setting and assembly is by fluorescent lamps in open-top fittings, the work being carried out in front of a white background so that the parts can be seen in silhouette. (Crompton Parkinson Ltd.)

7 Precision work at benches and machines

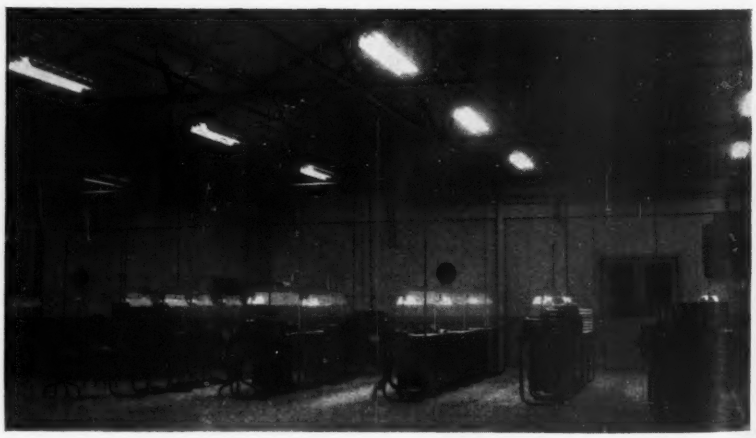
THE PROBLEMS

Achieving high levels of illumination; choice of method of local lighting—proximate or remote, fixed or adjustable, mains or low voltage; avoidance of direct and reflected glare and unwanted shadows; relation of local to ' ambient ' luminance; self-contained machine lights; design of special lighting devices; choice of light source; use of shadows.

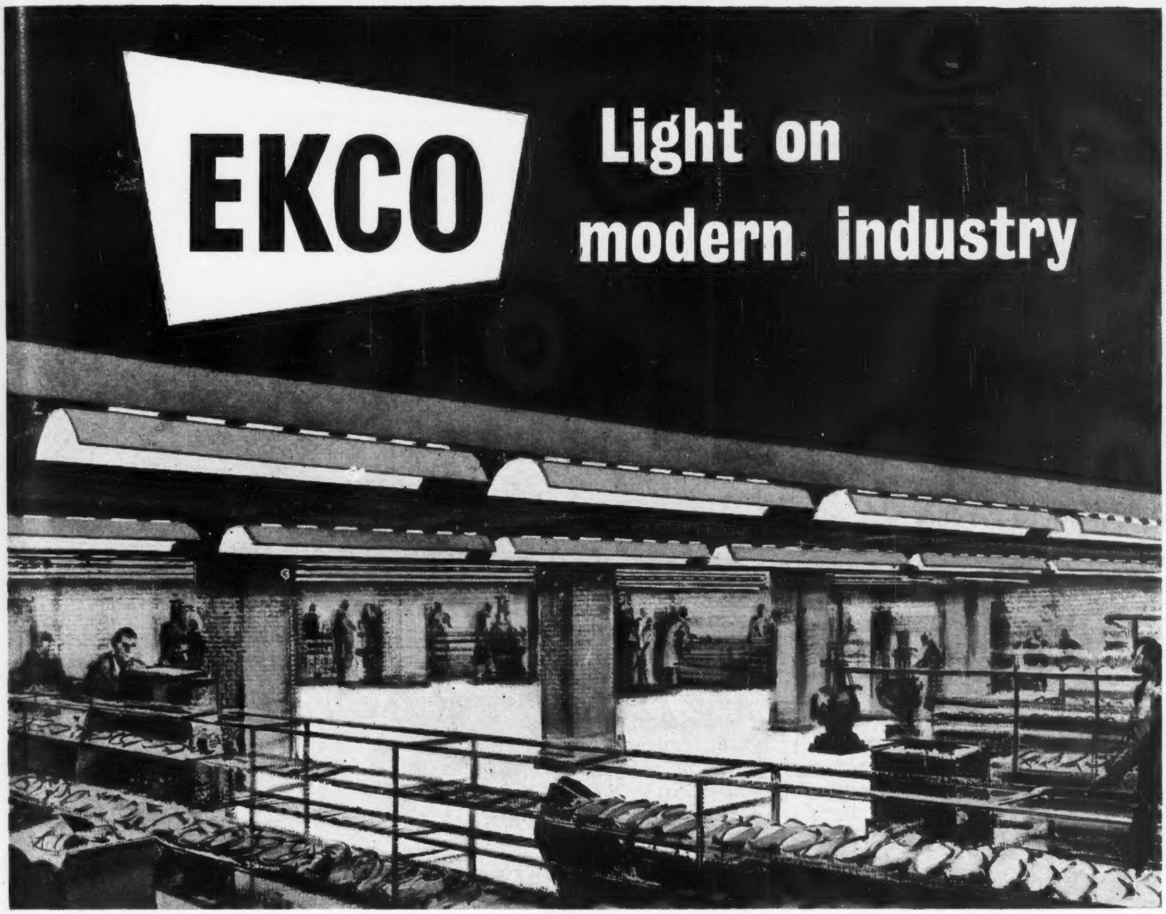
THE SOLUTIONS

HIGH levels of illumination for precision work can be provided in several ways. Firstly, by local lighting from tungsten lamps in fittings with concentrating reflectors. Secondly, by semi-local lighting—tungsten or fluorescent lamps in fittings arranged to give a concentration of light immediately over the benches. Thirdly, by general lighting from rows of fluorescent fittings or from a luminous ceiling.

If local lighting is used, there must also be background lighting of an intensity sufficient to prevent too great a contrast and consequent " eyestrain." As a rough guide, the background lighting should have a value equal to the square root of the local illumination level. When fixed to machines the fittings must be proof against mechanical shock or vibration. They must be able to be maintained without dismantling the machine, and, for some operations, such as lathe work, milling and grinding, they must be adjustable. If adjustment is likely to be frequent, or if the fitting is not fixed but can



Above, part of a lamp production line at the new B.T.H. lamp works, Buckie. General lighting is from twin 5-ft. fluorescent fittings suspended from the roof structure. Local lighting is provided by single-lamp fittings, mounted on conduit immediately above the work benches. (A.E.I. Lamp & Lighting Co. Ltd.)



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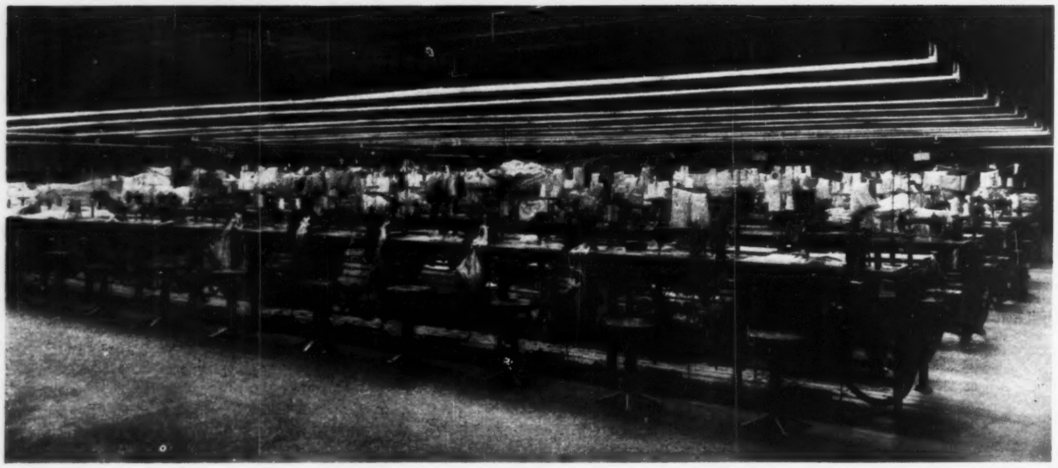


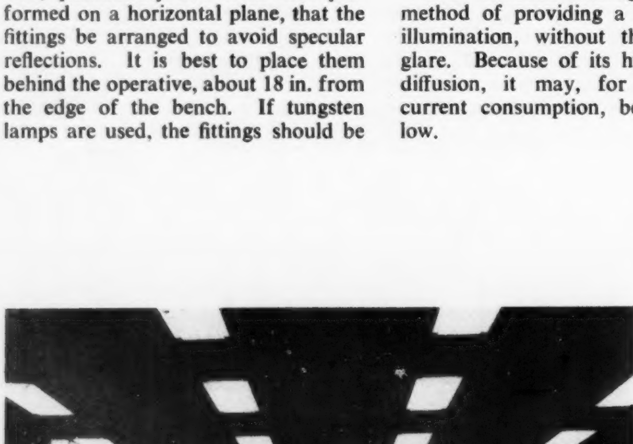
Precision work at benches and machines *(continued)*

Above, fine work on sewing machines at benches. Continuous fluorescent fittings at a low mounting height give a high level of illumination on the working plane. The reflectors have deep cut-off to prevent glare and give a proportion of upward light to reduce contrast. (Falk, Stadelmann & Co. Ltd.)

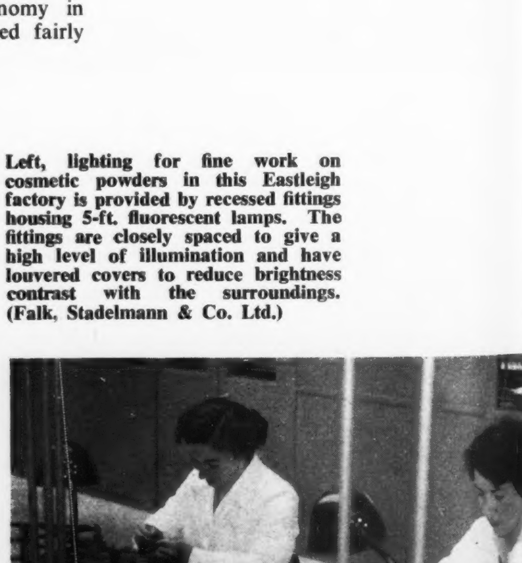
be moved within the limits of a flexible lead, it is usually recommended that low-voltage current—between 12 and 50 volts—be used.

For semi-local lighting it is important, particularly for work not performed on a horizontal plane, that the fittings be arranged to avoid specular reflections. It is best to place them behind the operative, about 18 in. from the edge of the bench. If tungsten lamps are used, the fittings should be placed between the operatives to prevent the latter from being in their own light. For general lighting, the fittings should, for economy, have reflectors of high efficiency.

The luminous ceiling is a good method of providing a high level of illumination, without the danger of glare. Because of its high degree of diffusion, it may, for economy in current consumption, be fixed fairly low.

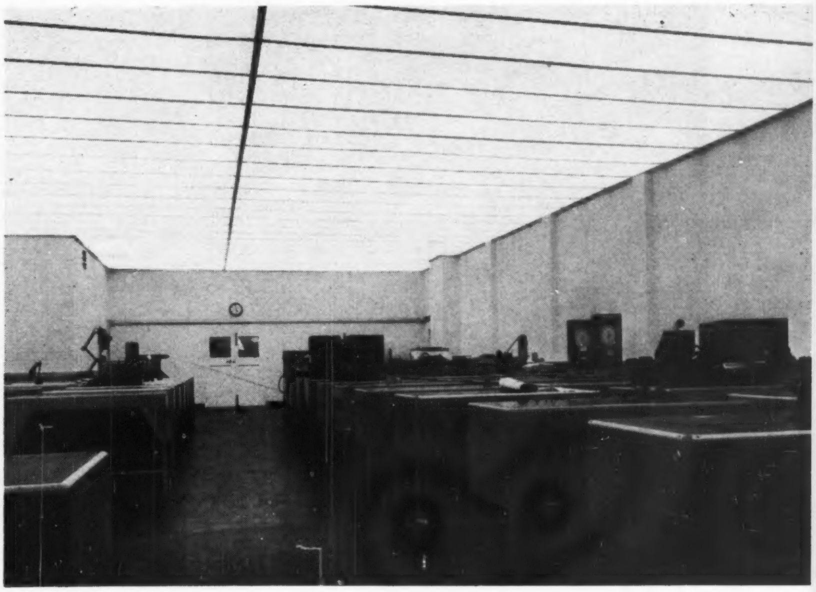


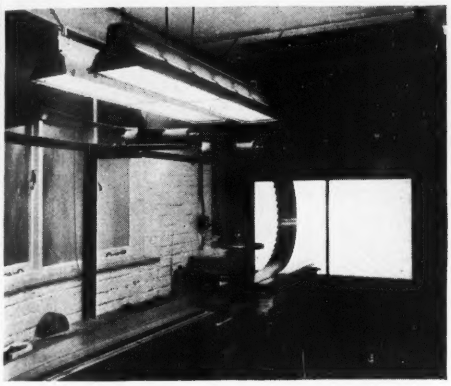
Left, lighting for fine work on cosmetic powders in this Eastleigh factory is provided by recessed fittings housing 5-ft. fluorescent lamps. The fittings are closely spaced to give a high level of illumination and have louvered covers to reduce brightness contrast with the surroundings. (Falk, Stadelmann & Co. Ltd.)



Right, precision work on the manufacture of 6-volt telephone exchange indicator lamps at the B.T.H. lamp factory at Buckie. Local lighting is from tungsten lamps in adjustable opaque reflectors supported by conduit. (A.E.I. Lamp & Lighting Co. Ltd.)

Right, a significant application for luminous ceilings is in industrial work where high levels of glare-free and shadowless lighting are required. This example is in the Gyro assembly room of Elliotts, Rochester. (Lumenated Ceilings, Ltd.)





Left, until recently it was thought that the "doctoring" of saws could be carried out only by daylight. Extensive experiments, however, evolved this method of artificial lighting. A 3 ft. x 5 ft. opal glass screen is lit by three 40-watt fluorescent lamps mounted 6 in. from the glass. Against this screen the saw can be studied in silhouette. Extra light above the bench comes from two fluorescent fittings at a mounting height of 7 ft. (Benjamin Electric Ltd.)

8 Assembly lines

THE PROBLEMS

Achieving suitable direction of light; provision of adequate illumination for rapid seeing; avoidance of glare—direct and indirect; avoidance of troublesome shadows.

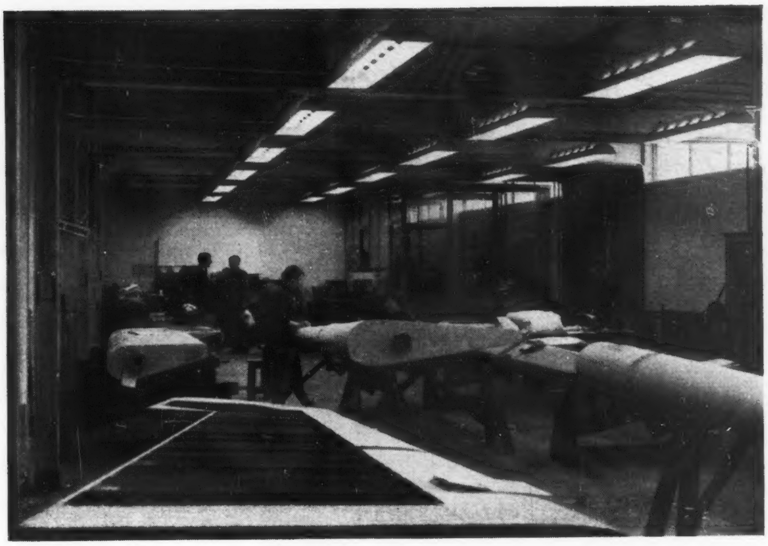
At the Rover factory, general lighting is from fluorescent fittings with open-ended reflectors. Lighting for the assembly lines consists of two rows of continuous trunking, each 444 ft. in length, mounted 8 ft above floor level. To the trunking are fixed fluorescent fittings with vitreous enamelled 45-degree angle reflectors which direct the light towards both sides of each line of vehicles. The illumination level on the centre of the bonnet is 60 lm/ft^2. (General Electric Co. Ltd.)

THE SOLUTIONS

WHERE conveyor lines are carrying large and bulky objects, the most satisfactory method of lighting is by fluorescent angle-type fittings. They should be mounted parallel to the line, at a suitable height above it and at a distance sufficient to ensure even lighting and prevent distracting images of the source appearing on specular surfaces. It may be desirable to provide louvres on the fittings to prevent workers on the opposite side of the line suffering from glare.

Troublesome shadows can be prevented by giving care to lateral spacing of the fittings.

Assembly lines *(continued)*



Trimming department of the Bristol Britannia assembly hall in the Bristol Aeroplane Company's works at Filton. The lighting is provided by fluorescent fittings with slotted reflectors which give a substantial proportion of upward light. (Thorn Electrical Industries Ltd.)

9 Inspection, testing and grading

THE PROBLEMS

Severity of the visual task; choice of specular or diffuse lighting; colour of light; glare and indirect glare; use of reflected images; importance of background luminance; relation of illumination level to speed of inspection; elimination or introduction of shadows.

THE SOLUTIONS

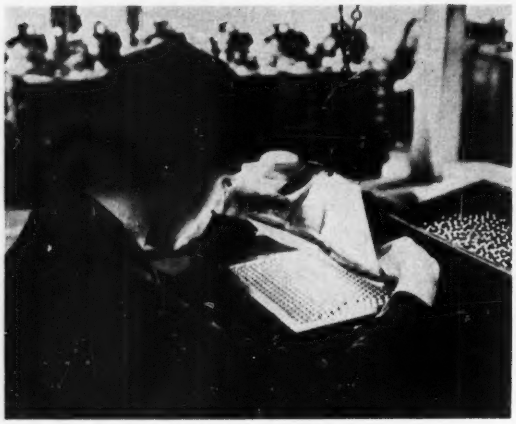
IN general, more light is required to inspect an article than to manufacture it, because the inspector is looking for small flaws on the finished product. There is a place for both specular and diffuse lighting. In the case of coil winding where the position of one specular object in relation to another has to be observed, the specular image of the light source reflected from adjacent turns facilitates inspection. Inspection of transparent objects is more conveniently carried out by using a diffuse light from a low-brightness large-area source in front of which the objects pass.

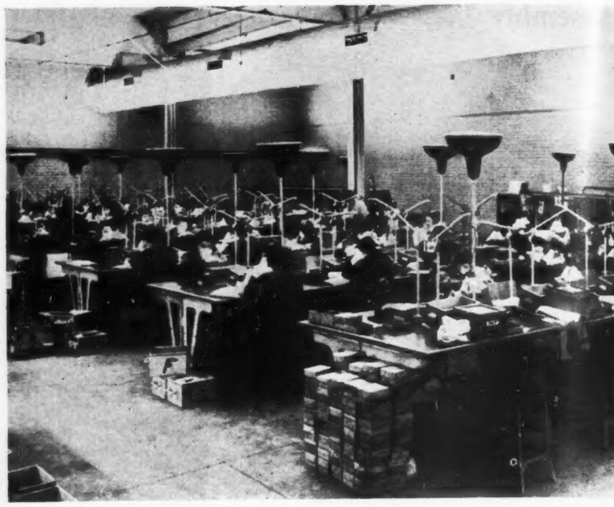
Where the relationship of a number of components to each other is the main object of inspection and where the shape is constant, a system of silhouette lighting in which the object is seen darkly against a light background is often best.

Shadows can sometimes be used to render objects more conspicuous. For

At the Wiggins Teape works at Dover, low-mounted fluorescent fittings are used over the inspection benches, while general light comes from fluorescent lamps in open-topped reflector units. For the local lighting a "cornice-type" reflector is used in an inverted position. (Crompton Parkinson Ltd.)

Inspection, testing and grading *(continued)*





Above and above left, the final inspection of ball bearings is a visual process, the examination being carried out by the use of an image obtained from a relatively large luminous surface. Local units with diffusing fronts are suspended over the benches. General lighting is provided indirectly by standard reflectors mounted upside down at a height of 7 ft. above floor level. They are fitted with glass covers to facilitate cleaning. (Benjamin Electric Ltd.)

example, under a diffuse lighting system the raised letters of type castings blend into their background, but with highly directional lighting the shape of each letter is easily seen against the shadow it casts.

The speed at which inspection is to be performed affects the degree of illumination required. More light is needed to identify or inspect a moving object than is required if the object is stationary.

For the testing of tea, good colour rendering is required and, if the work is carried out by daylight and by artificial light, it is important that the latter closely resemble the former. In the tea-testing section of Watling House, Cannon St. (the London headquarters of Brooke Bond Ltd.), there is a north-light roof, around the periphery of which has been fixed a continuous row of fluorescent fittings with diffusing "Perspex" covers. In addition, there is at the base of the north-light glazing a row of batten-type fittings lighting the sloping roof. Colour-matching lamps are used and the illumination level is between 20 and 30 lm/ft^2. (Siemens Edison Swan Ltd.)

HOME LIGHTING

PART 5 - - - - - - Bedroom and Bathroom

An investigation in six parts by Derek Phillips, M.Arch. (M.I.T.), M.C.D., B.Arch. (L'pool), A.R.I.B.A.*, into the relationship between architecture and lighting in the modern home.

THE bedroom and the bathroom have been coupled together in this article for no other reason than that they are both rooms in which people spend most of their time in a state of semi-undress. At its best the human form may be worthy of minute scrutiny but, the average being a good deal less than "the best," the essence of good bedroom lighting—both natural and artificial—is to provide light only where it is really needed, and to be able to cut it out when it is no longer required.

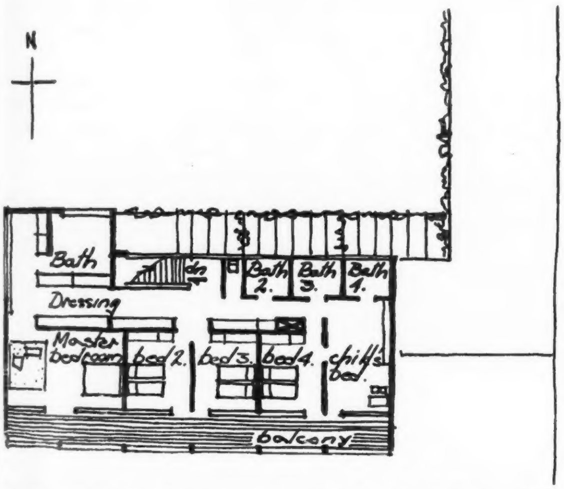


Fig. 1. First-floor bedrooms plan of the Halland House, 1938. Designed by Serge Chermayeff. (Illustrated in the first article in this series.)

The Bedroom

Despite the influence of Le Corbusier, the bedroom to-day differs little from that of our grandfathers. The Gallic logic of a monastic cell large enough to accommodate a bed and little else has proved unacceptable: either we have refused to acknowledge this rationalisation of space, or, what is perhaps more probable, Le Corbusier underestimated the needs which a bedroom satisfies. The idea of the bed-sitting room may have been imposed on us by modern space standards, but the bedroom has always been a second sitting room—a place to retire to when family life becomes intolerable; a place to rest in, to work in and to be comfortably "indisposed" in. We read, write, listen to the radio, smoke and sometimes eat in our bedrooms, as well as dressing, undressing, sleeping, etc.

How then, if at all, should the modern bedroom differ from its predecessors? Firstly, the individual items of furniture—the wardrobe, chest-of-drawers and dressing table—can be replaced by carefully dimensioned, built-in storage units designed to fit the goods they are to house. Secondly, the windows should be consciously proportioned elements in the design of the room, not simply a rectangular "hole" in the wall in front of which the dressing table is placed. (See Fig. 1).

The lighting requirements of a bedroom are twofold:

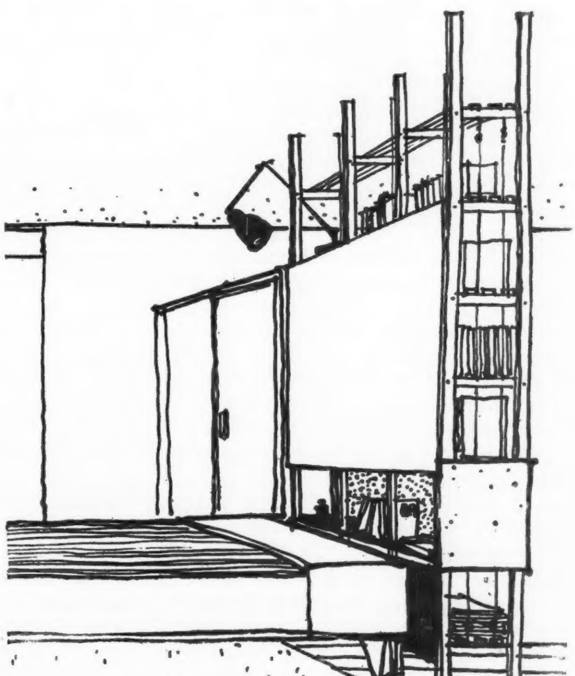


Fig. 2. An example of bed-head lighting taken from the author's own home. A white-painted panel is fixed to the bookshelf unit dividing the bedroom from the study. The panel is lit from above by an adjustable fitting which can also be used in the study.

*Consultant architect to the A.E.I. Lamp and Lighting Co., Ltd.

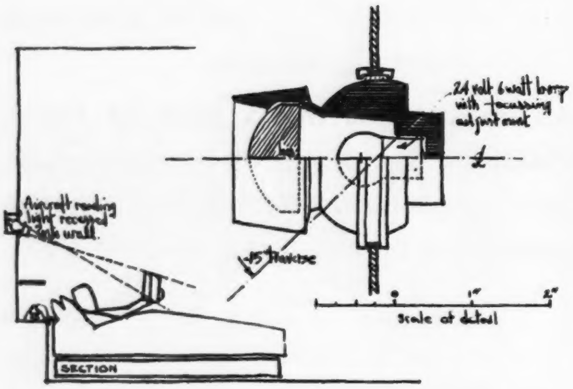


Fig. 3. Use of aircraft reading light (see detail) for reading in bed.

lighting for reading and similar activities, and general background lighting. In addition, provision should be made to *exclude* light, to facilitate sleeping after sunrise. The IES recommends 3 lm/ft^2 for the lighting of bedrooms and this is certainly adequate for the general lighting, though higher levels are required at certain points at certain times—at the mirrors, for example.

The lighting of mirrors has received a good deal of attention in the past and various methods have been evolved. Manufacturers have even developed special equipment for the purpose, which usually takes the form of a line of light down each side of the mirror. This arrangement lights the face but, at the same time, it can act as an unpleasant source of glare which distracts the eye from the image in the glass. A better solution is to light the face from above and from the sides with large-area sources—an arrangement that is facilitated if the architect, when he designs the bedroom, provides a small alcove for the mirror, with recesses on either side. In these recesses fluorescent lamps can be concealed behind diffusing glass or plastic, and similar lighting can be provided above the mirror. If possible, the position of the alcove should be such that, during the day, it is lit by daylight. The light source usually preferred is de luxe warm white, though if the mirror is to be used mainly by a woman a pink light may be considered more flattering.

For reading in bed the the lighting should be arranged that it falls on the book at the correct angle, while the source itself is not seen. One method is to " bounce " the light from a reflective panel behind the bed (see Fig. 2). In rooms with a double bed it is advisable that one person should be able to sleep whilst the other reads, and a lesson can be learnt from aircraft-seat lighting, where the problem has been solved by using small " pinhole " spotlights, with the light source recessed so deeply that it cannot be seen. This type of fitting delivers a circle of light about 1 ft. in diameter (see Fig. 3). If it were made adjustable it would be a most suitable method of lighting for reading in bed, enabling one person to read in the middle of the night without disturbing the other. It should be remembered, however, that without background light no lighting for reading can be ideal. Hence alternative lighting should be provided for reading at other times which will allow an " overspill " of light to relieve eye-strain.

Depending upon the layout and arrangement of the bedroom, other special lighting may be required. If there is a wash basin, this must be treated in a similar manner to the wash basin in the bathroom (see below); if there is a desk, this must have a suitable light source related to it. Lighting should be provided also for built-in furniture, closets, drawers, etc., and it is to be hoped that manufacturers will eventually produce cheap fittings suitable for this purpose. They might be similar to those made in the United States for the lighting of the " pockets " of motor cars. The introduction of a 24-volt circuit would be of value. This could be provided by an inexpensive transformer, as used for bells, and would be used for the aircraft-type reading lamps and the drawer and cupboard lighting.

There are many ways of achieving an adequate level of general illumination for the bedroom. The chief characteristic should be " soft " light and, where tungsten sources are used, the " pink pearl " lamp is suitable. Indirect lighting is an effective and appropriate method, and this may be achieved, as in Fig. 4, by lighting the ceiling by light beams concealing fluorescent lamps (de luxe warm white) or by lighting a wall. The wall chosen will depend on the circumstances; one can illuminate the curtains, if they are light in colour, or a wall of built-in storage units, if these have a surface finish which is highly reflective. This latter arrangement has the advantage that it provides good local light for dressing.

The exclusion of daylight is sometimes difficult to achieve without excluding air too. For the traditional type of window, venetian blinds may be used. Alternatively, built-in ventilation at top and bottom allows the window to be darkened by heavy curtains.

Important, also is the provision of sufficient light for moving about the room in the middle of the night, when the eyes are " night adapted." We have all suffered from

(Continued on p.318)

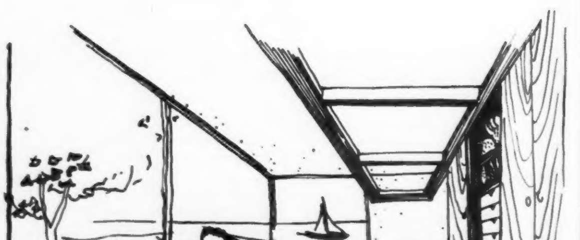


Fig. 4. Indirect system of lighting, drawn from memory, of the bedroom in Ted Wakefield's house, Vermilion, Ohio. (The light sources concealed in lowered beams related to wardrobe unit. View of Lake Erie free from sunrise onwards !)

(Continued from p.316)

the shock of switching on the light and being blinded by the brilliance of an illumination level which normally might seem quite low. There is a need, therefore, for a secondary circuit for night use, giving very low illumination, possibly at skirting level, as in hospital corridors. An alternative solution might lie in electro-luminescent panels which could be placed at strategic places in a house and left running all night. (Low-wattage tungsten lamps behind diffusing panels would achieve the same effect; they could be supplied from the 24-volt circuit suggested above.) Some arrangement of this nature is particularly important where there are children who may need attention at any time during the night. The running costs are very low, and the gain in the elimination of accidents and ease of seeing, incalculable.

The Bathroom

The bathroom differs from its Victorian counterpart by being smaller, though it is usually placed in a more important position. Far from being tucked into any odd corner, the bathroom to-day is related carefully to the bedroom planning and, in a medium-sized house, there is often more than one. It is not uncommon for the master bedroom to have its own bathroom, with one or more others for children, guests or maids' rooms. Simple ventilation equipment enables the bathrooms to be planned internally, and they may be lit from roof lights or even rely entirely on artificial lighting.

The fundamental elements of a bathroom have not changed—the bath, the basin, and possibly the w.c. The bath will almost certainly be built-in, and the basin may be placed in a counter, which can be used for the usual array of toilet articles. The lighting, therefore, must be of a sufficiently general character to give adequate illumination (about 5 lm/ft^2) to the bath or shower, and a higher level at the mirror. The problem of lighting the mirror is the same as in the bedroom (as described above), with greater importance attached to light under a man's chin. Wide area sources above and at the side are the best solution.

For general illumination a recessed fitting in the ceiling is ideal, as this may have a glass or plastic diffuser which can be made moisture-proof to avoid damage by condensation. A solution incorporating both these suggestions is shown in Fig. 5.

In America fully luminous ceilings have been tried in bathrooms and, where these are well related to the space, the effect is good, the nature of the light being suitable for the hygienic well-lit appearance we associate with bathrooms. With this system, however, it is difficult to keep the illumination level from being unnecessarily high.

Natural lighting for bathrooms in the States is generally at high level, and is sometimes provided by circular domed roof lights. Where this is done it is possible to arrange for the general artificial lighting to come from the same position, by placing lamps outside the dome, shining on the walls of the bathroom; the effect is good, but it may prove too much of a maintenance problem for the average home owner.

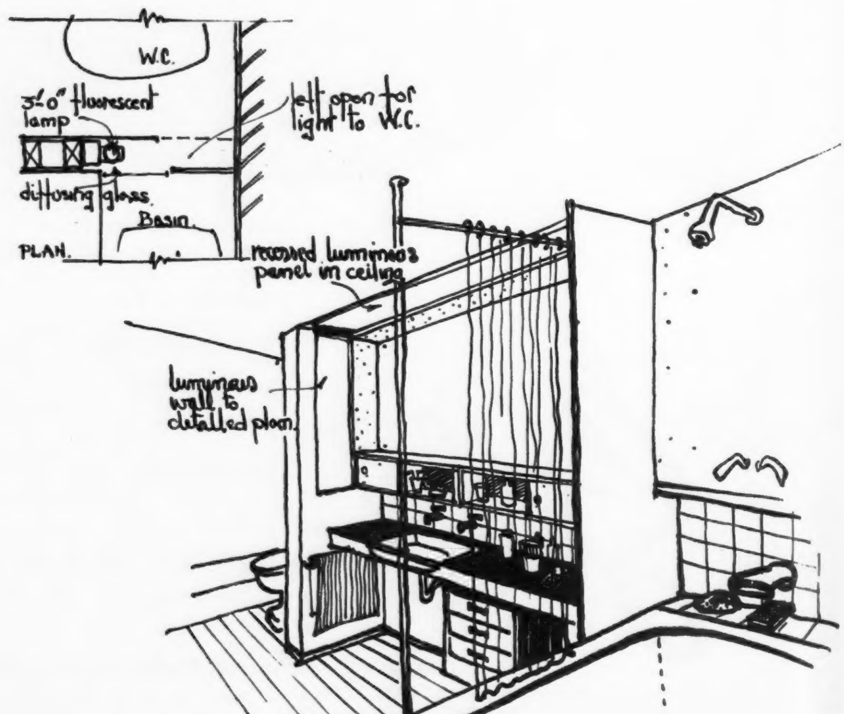


Fig. 5. Bathroom lighting scheme, showing suggestions for lighting mirror, with borrowed light to w.c. Bath and shower areas receive sufficient light "spilt" from other areas.

I.E.S. ACTIVITIES

Vice-Presidents and Regional Chairmen, 1957-1958

VICE-PRESIDENTS

F. X. Algar

Mr. Algar, B.E., B.Sc., M.I.C.E.I., F.I.E.S., joined the Electricity Supply Board of Ireland in 1928, where he is responsible for the Board's lighting activities, including the Lighting Bureau, and for street lighting throughout Eire excluding only the City of Dublin. He is Hon. Sec. of the Irish National Committee on Illumination and is on the Executive of the NIC.

N. Boydell

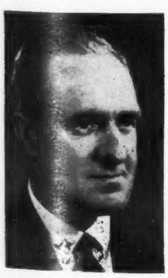
Mr. Boydell, M.I.E.E., A.M.I. Mech.E., has been in the Electricity Supply Industry for most of his career. Formerly Borough Electrical Engineer and Manager at Eastbourne, since nationalisation he has been Area Manager for East Sussex and South-West Kent for the S.E. Board. He is a past-president of the APLE.

R. G. Hopkinson

Dr. Hopkinson studied at Faraday House after which he joined the GEC Research Laboratories. In 1947 he went to the Building Research Station where he is in charge of lighting research. He has twice received the Leon Gaster Memorial Premium and has served on several IES committees.

J. S. McCulloch

Mr. McCulloch is a partner of R. W. Gregory and Partners. He received his technical education at Rutherford Technical College and in 1952 joined Merz and McLellan. In 1936 he joined his present firm and is engaged on the design of mechanical and electrical services for shipyards, factories and other buildings. He received the Leon Gaster Memorial Premium in 1953.



C. C. Smith

Mr. Smith received his early training with the Liverpool Corporation Electric Supply Department. He served in the REs during the war. He was appointed Deputy City Lighting Engineer of Liverpool in 1946 and City Lighting Engineer in 1948. He is a past chairman of the Liverpool Centre and a past president of the APLE.

REGIONAL CHAIRMEN

Bath and Bristol

Mr. R. H. Hill served an apprenticeship with the B.T.H. Co., Ltd., after which he spent some time in the company's lamp works. After service with the Royal Signals during the war he joined the staff of the Research and Development Laboratory of Ekco-Ensign Ltd. Since 1950 he has been Sales Engineer in the south-west for Benjamin Electric Ltd.

Birmingham

Mr. G. E. Kemp, Assoc. I.E.E., is District Commercial Engineer of the Dudley District of the Midland Electricity Board; before nationalisation of the supply industry he was District Assistant with the S.W. and S. Power Company. He is a keen sports enthusiast, is a Class 1 soccer referee and is well known among local athletic organisations.

Cardiff

Mr. M. E. McCann, Dip. M.I.E.S., joined the General Electric Co. Ltd. in 1929 and first went to their Illuminating Engineering Dept. in Cardiff in 1931. Before the war he was transferred to the Bristol office and is now back in Cardiff where he is responsible for the Exterior Lighting Dept.

Edinburgh

Mr. W. J. Burland, Dip.M.I.E.S., served an apprenticeship with Fraser and Borthwick, Ltd., in Glasgow, after which he joined the Glasgow office of the B.T.H. Co., Ltd., as a sales representative. For five years he was Scottish Manager for the "Z" Electric Lamp and Supplies Co., Ltd. He now represents the AEI Lamp and Lighting Co. Ltd., in Central Scotland.

Glasgow Centre

Mr. W. K. Cumming, A.M.I.E.E., Dip.M.I.E.S., served an apprenticeship with James Kilpatrick & Son Limited, and joined Metropolitan-Vickers Electrical Co. Ltd. as lighting engineer for Scotland in 1947. He is now Lighting Superintendent for the Scotland and Northern Ireland Region of the AEI Lamp and Lighting Co. Ltd.

Gloucester and Cheltenham

Mr. Richard V. Parsons served an apprenticeship with his father's firm in Gloucester, after which he served six years with the Royal Air Force during the 1939/1945 war in the ground radar section. After the war he returned to the family electrical business, which was formed into a limited company in 1946. He is now a director of the company.

Newcastle

Mr. R. J. Fothergill, B.Sc., A.M.I.E.E., received his practical training in industry in the north-east, in the Army during the war, and with A. Reyrolle & Co. Ltd. For the past six years he has been Area Engineer responsible for all activities of the Lighting Service Bureau in the four northern counties. He was Honorary Secretary of the Centre from 1951 to 1956.

Leeds

Mr. J. K. Frisby, Dip.M.I.E.S. was trained in lighting engineering in the Lighting Department of the B.T.H. Co. Ltd. in London. He took charge of the company's lighting department in Leeds in 1949. On the formation of the new A.E.I. Lamp & Lighting Co. in 1955 he was appointed Assistant Regional Manager, N.E. Region of the company.

Nottingham

Mr. I. A. A. Macdonald has been in the Electricity Supply Industry for the whole of his career. In 1938 he became manager of the Midland Electric Light and Power Company Limited and on nationalisation was appointed Manager of the Leamington and Warwick District of The East Midlands Electricity Board. Since 1953 he has been Manager of the Ilkeston District of that Board.

Leicester

Mr. A. Y. Johnson has been in the electrical industry for 25 years. He joined the G.E.C. Ltd. in 1938, and, after war service in the Far East, he returned to the Leicester branch of the company to become manager of the Lighting and Appliances Dept. He spent a period of training at the company's Research Laboratories and is now Branch Lighting Engineer.

Sheffield

Mr. F. Smith, A.M.I.E.E., trained at the Royal Technical College, Salford, and with the Lancashire Dynamo & Motor Co. Ltd. He held positions with Met.-Vick, and in the Electricity Departments at Manchester and Sheffield. He joined Siemens Bros. & Co. Ltd. in 1947 as Sales Engineer, Sheffield, and was appointed Assistant Area Manager in 1955.

Liverpool

Mr. W. V. Parkinson, B.Sc., M.I.E.E., spent three years with Siemens Bros. & Co., Ltd., after which he joined the Liverpool Corporation Electric Supply Department. After war service with the Royal Engineers he returned to Liverpool, where he was appointed Meter and Test Superintendent. In 1948 he was appointed Assistant Chief Commercial Officer with the Merseyside and North Wales Electricity Board.

North Lancashire

Mr. Sydney Mountain, D.Opt., F.B.O.A., qualified in ophthalmic optics during the early part of the war at Manchester and subsequently served as an officer in the R.A.F., where he was engaged in flying duties. After the war he commenced in private practice. He has specialised in the field of industrial eye work, serving several large industrial undertakings as an advisory ophthalmic officer.

Manchester

Mr. Percy Corry has been Manager of the Manchester Branch of the Strand Electric and Engineering Co. Ltd., for over 20 years, and is also Managing Director of Watts and Corry, Ltd. He has written several books on theatre planning and stage lighting. He entered the lighting industry via the theatre, in which he has had varied experience as actor, producer and technician.

Stoke-on-Trent

Mr. D. C. Harris received his technical training at the North Staffs Technical College and is a director of Francis W. Harris & Co. Ltd., of Stoke-on-Trent and Leek. He held a commission in the Royal Artillery during the war and has been connected with the work of the Society in Stoke-onTrent since the early days of the Group.

Swansea

Mr. D. B. Francis was formerly with Verity's Ltd., Birmingham, and subsequently with The Steel Company of Wales, Ltd. He joined the Revo Electric Co. Ltd. in 1953 and is now engaged in their Lighting Division covering the South Wales area.

Tees-side

Mr. D. Bradshaw completed his early education at the Grammar School, Gateshead, and in 1950 began his career in lighting with the Newcastle branch of the G.E.C. Ltd. After a period at the research laboratories and head office he returned to the North-East and was appointed manager of the company's Lighting Department, Middlesbrough, in June, 1956.

FORTHCOMING EVENTS

LONDON

October 8

Presidential Address, "Designing for Harmony," by E. B. Sawyer. (At the Royal Institution, Albemarle Street, London, W.1.) 6 p.m.

CENTRES AND GROUPS

October 1

STOKE-ON-TRENT.—"The Polar Aurorae," by G. E. Kemp. (At the North Stafford Hotel.) 6 p.m.

October 2

EDINBURGH.—"Lighting in the Home," by D. P. Bliss and H. Hellier. (At the Y.M.C.A. Social Room, 14, South Saint Andrew Street, Edinburgh.) 6.15 p.m.

NEWCASTLE UPON TYNE.—Annual General Meeting and Chairman's Address, by R. J. Fothergill. (At the Large Lecture Theatre, Grey Hall, Dept. of Electrical Engineering, King's College, College Road, Newcastle upon Tyne 1.) 6.15 p.m.

SWANSEA.—Chairman's Address, by D. B. Francis. (At the Demonstration Theatre, South Wales Electricity Board, The Kingsway, Swansea.) 6.30 p.m.

October 3

CARDIFF.—Visit to B.B.C. Television Transmitter, Wenvoe.

GLASGOW.—"Lighting in the Home," by D. P. Bliss and H. Hellier. (At the Lighting Service Bureau of Scotland, 29, St. Vincent Place, Glasgow C.1.) 6.30 p.m.

October 4

NOTTINGHAM.—Annual Ladies' Evening. (At the Welbeck Hotel, Nottingham.)

October 10

NOTTINGHAM.—Chairman's Induction and Visit of the President. (At the Demonstration Theatre, East Midlands Electricity Board, Smithy Row, Nottingham.) 6 p.m.

October 14

SHEFFIELD.—Chairman's Address, by F. Smith. (At the Grand Hotel, Sheffield. 6.30 p.m

October 15

LIVERPOOL.—Chairman's Address, by W. B. Parkinson. (At the Committee Rooms of the Liverpool Passenger Transport Office, 24, Hatton Garden, Liverpool 3.) 6 p.m.

October 16

NORTH LANCASHIRE.—Presidential address by E. B. Sawyer. (At the Demonstration Theatre, The North Western Electricity Board, 19, Friargate, Preston.) 7.15 p.m.

TEES-SIDE.—"Interior Decorating and Lighting," by L. Wilson. (At the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.) 6.30 p.m.

TRANSVAAL.—"Lighting Materials." (At Room 95, Public Library, Johannesburg.) 8 p.m.

October 17

MANCHESTER.—"The Stage and the Lighting Engineer," by F. P. Bentham. (At the Demonstration Theatre, N.W. Electricity Board, Town Hall, Manchester 2.) 6 p.m. Light refreshments from 5.30 p.m.

October 21

BATH AND BRISTOL.—"Lighting as an Effective Aid to Architecture," by H. E. Bellchambers. (At the Royal Hotel, Bristol.) 7 p.m.

October 22

GLOUCESTER and CHELTENHAM.—"Home Lighting." (At the Fleece Hotel, Westgate Street, Gloucester.) 6.30 p.m.

October 25

BIRMINGHAM.—"Horticultural Lighting," by A. W. Gray. (At Regent House, St. Phillip's Place, Colmore Row, Birmingham.) 6 p.m.

October 28

LEEDS.—"Lighting at London Airport," by J. G. Holmes. (At the Lighting Service Bureau, 24, Aire Street, Leeds 1.) 6.15 p.m. Refreshments from 5.30 p.m.

LEICESTER.—"Lighting as a Basis for Design," by Derek Phillips. (At the Demonstration Theatre, East Midlands Electricity Board, Charles Street, Leicester (entrance Rutland Street).) 7 p.m.

October 29

LEEDS.—"Lighting at London Airport," by J. G. Holmes. (At the Yorkshire Electricity Board, Ferensway, Hull.) 6.30 p.m. Refreshments from 6 p.m.

November 20

TRANSVAAL.—Forum on Lighting Materials. (At Room 95, Public Library, Johannesburg.) 8 p.m.

Situations

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The IES has played a major part in the development of better lighting everywhere to the direct benefit of industry. The following is a list of companies and organisations who show their appreciation of the work of the IES by being Sustaining Members of the Society. There are many more firms whose businesses have prospered in no small way because of the work of the IES and who should therefore help to sustain the Society.

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British Electrical Development Association.
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British Luma Co-operative Electric Lamp Society Ltd.
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The Cinematograph Exhibitors' Association of Great Britain and Ireland.
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George Davidson and Co., Ltd.
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Eastern Electricity Board.
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East Midlands Electricity Board
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Edmundsons Electric Co., Ltd.
E.G.S. Company Ltd.
Ekco-Ensign Electric Ltd.
Electric Lamp Industry Council
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Electrical Components Ltd.
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Evans Electroselenium Ltd.
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North-Western Electricity Board.
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S. A. Philips (Pty.) Ltd., Johannesburg.
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Wm. Sugg and Co., Ltd.
Superconcrete Pipes (S.A.) Ltd.
Thermo-Plastics Ltd.
Thorn Electrical Industries (S.A.) Pty. Ltd., Johannesburg.
F. W. Thorpe Ltd.
Troughton and Young, Ltd.
Tucker and Edgar (Teeanee, Ltd.)
Verity's Ltd.
Walsall Conduits Ltd.
J. Walton (Electrical) Ltd.
Wardle Engineering Co., Ltd.
J. M. Webber and Co., Ltd.
Whitworth Electric Lamp Co., Ltd.
Wokingham Plastics Ltd.
A. J. Wright (Electrical) Ltd.
Yorkshire Electricity Board.
Z Electric Lamp and Supplies Co., Ltd.

Lighting Abstracts

OPTICS AND PHOTOMETRY

535.241 : 535.37

508. Standard of low luminance for the study of the light of the night sky.

D. Barbier *and* P. Leveque. *Rev. d'Optique,* **36,** 132-134 (*Mar.,* 1957). *In French.*

A luminance standard is formed by a layer of Willemits excited by Strontium 90, an arrangement having an adequate stability of luminance with time and temperature.

J. M. W.

535.24

509. On the systematic error of flicker photometry in hetero-chromatic photometry.

Y. Galifret *and* H. Pieron, *Rev. d'Optique,* **36,** 157-170 (*April,* 1957). *In French.*

Photometric matches were carried out by the methods of direct comparison, cascade and flicker on fields derived from monochromatic and white light mixtures. It was concluded that the flicker method involves a serious underestimation of the luminance of coloured fields when they are compared with achromatic fields or fields of low saturation. The effect is greatest in the red and green, and is small for the blue.

J. M. W.

535.36 : 628.93

510. Visibility of light sources in fog: effect of luminances due to natural light.

J. Olivier, *Rev. d'Optique,* **36,** 105-131 (*Mar.,* 1957). *In French.*

The author continues previous studies of this subject. The brightnesses in a fog layer are calculated for both diffuse incidence and for the case of diffuse plus sunlight, for various orientations and at various depths. The effect of assumptions of the diffusion index on luminances in the upper part of the fog layer are discussed. The application to the visibility of signal lights from the air is discussed. It is concluded that oblique visibility of signal lights can be calculated if the following data can be measured: (i) horizontal optical density, (ii) horizon luminance, (iii) mean vertical density between ground and the altitude concerned.

J. M. W.

612.843.5

511. Experimental equipment for study of flicker: results of measurements on L.T. networks.

A. Dejon *and* P. Gaussens, *Bull. Soc. Franç. Elect.* (*Ser.* 7), **7,** 263-272 (*Mar.,* 1957). *In French.*

It is very difficult to evaluate a given degree of flicker by a marking system, or to compare two flickers if they are separated in time, but it is easy to adjust them to equality if they are experienced in immediate succession. A versatile electronic flicker generator was built capable of producing continuous, interrupted, or isolated flicker with sinusoidal, sawtooth or square wave forms, at frequencies from 0.1 to 33 cps. To record the flicker, a crest oscilloscope was built which could be applied either to the supply or to a photocell. To measure flicker a filter circuit with the appropriate characteristics was built whereby the equivalent amplitude at 10 cps. appears on a voltmeter, or its integral with respect to time on a square-law electricity meter. Flickers resulting from various motors, welders and arc furnaces are examined.

J. M. W.

612.843.5

512. Determination of the experimental laws of flicker, with application to irregularities in supply voltage.

P. Ailleret, *Bull. Soc. Franç. Elect.* (*Ser.* 7), **7,** 257-262 (*May,* 1957). *In French.*

In order to assess the visual discomfort due to irregularities in supply voltage, either periodic or chance, tests were made to establish laws relating flicker of varying type and frequency. The tests were made on a population of adults of both sexes engaged in reading, the lamp being out of the field of view. The amplitude of sinusoidal flicker which produces various recognisable degrees of discomfort was found as a function of flicker frequency. Flicker can conveniently be expressed in terms of the amplitude of a flicker at 20 cps which produces the same discomfort. It was found that (1) if two sinusoidal flickers at different frequencies produce the same discomfort, then if their respective amplitudes were multiplied by a common factor, they will again produce the same discomfort. (2) For intermittent sinusoidal flicker, the same discomfort is produced if the value of the integral $\int A^2\,dt$ is the same, where A is the amplitude. (3) If two sinusoidal flickers produce separately degrees of discomfort matched by a_1 and a_2 at 20 cps, then when superimposed the resulting discomfort would be matched by an amplitude at 20 cps if $\sqrt{a_1^2 \text{ and } a_2^2}$. From these results it appears that the eye can be considered as a filter circuit with particular characteristics. If these are combined with the characteristic of the lamp, an overall weighting curve is obtained whereby variations in supply voltage can be assessed in terms of discomfort, and to derive a figure of merit for quality of service.

J. M. W.

LIGHTING

513. A field check on school lighting costs. 628.972

W. Allphin, *Illum. Engng.,* **52,** 361-362 (*July,* 1957).

Opportunity was taken to measure the illumination levels and lighting loads in eight classrooms in each of two new schools in Danvers, Massachusetts, one school being lit with 300-watt tungsten lamps and the other with fluorescent lamps. When corrections had been applied to the measurements so that they all related to the same average illumination level of 30 lm/ft^2 at the end of 40 weeks of operation, it was found that the tungsten installation required 37,600 KWH, while the fluorescent installation required only 13,500 KWH.

P. P.

514. Report on high frequency operation. 621.327.43

R. H. Horner, *Illum. Engng.,* **52,** 359-362 (*July,* 1957).

Five thousand sq. ft. of office space have been lighted to 100 lm/ft^2 by a high frequency fluorescent installation operating from a rotary converter giving 400 volts at 840 cps. Greater lamp efficiency enables one third of the lamps required with conventional supplies to be dispensed with. This, together with the simpler wiring and control gear and the saving in air-conditioning equipment, more than offset the cost of the converter.

P. P.

515. The problem of interreflections in lighting. 628.93

J. Dourgnon, *Bull. Soc. Franç. Elect.* (*Ser.* 7), **7,** 226-229 (*April,* 1957). *In French.*

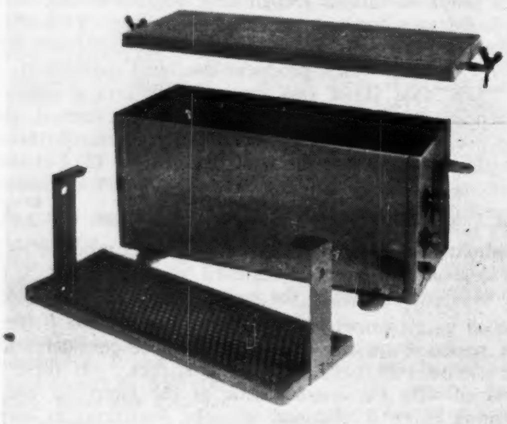
The author develops, on the lines of Waldram's method, a matrix expression for interreflection which would permit electronic calculation of utilisation factor.

J. M. W.

NEW PRODUCTS

Floodlighting lanterns

Rowlands Electrical Accessories Ltd. announce a new range of floodlighting lanterns. Included is a new weatherproof universal control gear-box made of heavy-gauge sheet steel which has been treated by the cold galvanising process to make it corrosion resisting. The box incorporates an easily removable tray made of perforated metal enabling control gear of a variety of sizes and makes to be fixed securely in position without drilling. A new trough fitting for 45-60-



Above, showing component parts of the REAL control gear-box. Below, new sodium lamp floodlight mounted on the control box.

watt sodium lamps has a "slide-on" front glazed cover frame, the design of which permits the fitting to be used for either downward or upward lighting. A new mercury lamp lantern for short- or medium-range lighting of buildings incorporates a specular parabolic asymmetric reflector.

Illuminated ceiling

J. A. Wilson Lighting and Display, Inc., announce a new illuminated ceiling, called the "Paragrid-Tile," which it is claimed has the necessary aesthetic qualities and long life and incorporates a new suspension technique which reduces installation costs by half. The improved lighting distribution obtained with this type of ceiling is said to make its use possible in areas of low ceilings. The "Paragrid-Tile" is precision moulded of light-stabilised specially pigmented polystyrene; the modular size is 16 in. x 16 in., and it is of bi-planar louvre construction with ½-in. square apertures. The tiles are suspended between specially designed ⅜-in. "U-Trax" metal channels.

"Perspex" closure for fluorescent fittings

A new "Perspex" closure for use with 5-ft. fluorescent reflector fittings is announced by the AEI Lamp and Lighting Company Ltd. This simple "Perspex" closure is designed primarily to prevent dust from entering the fitting but also to trap broken glass in the event of a lamp breakage. Manufactured from ⅛-in. clear "Perspex," the closure is shaped to fit the rim of the reflector to which it is attached by six clamps adjusted by knurled nuts. It can be used with all reflector fittings in the F1162 and F1163 range with the exception of those with "Perspex" reflectors. Price of the closure is £7 18s.

Trade Notes

Morley's Electrical Services (Holloway) Ltd.

To accommodate expanding business the factory, trade counter and stores of Morley's Electrical Services (Holloway) Ltd. have now moved to larger premises at Lowman Road, London, N.7.

Fluorescent lamps

The AEI Lamp and Lighting Co., Ltd., and the GEC Ltd. now guarantee to replace any standard fluorescent lamp in the 15-125-watt range which fails within 12 months or before 3,000 hours of use, whichever is the shorter.

The increasing popularity of the 8-ft. 125-watt fluorescent lamp has resulted in a lowering of the price of the lamps made by the GEC Ltd., AEI Ltd., Atlas and Ekco-Ensign from 25s. to 20s. each.

Thorn Electrical Industries Ltd.

Thorn Electrical Industries Ltd. plan to invest more than £A2,000,000 on a development project in Victoria, Australia, as a further stage in a scheme designed eventually to provide production facilities in Australia for the complete range of Thorn products. No date has yet been fixed for the commencement of building operations on a five-acre site at Heidelberg, but the cost of the first factory wing will exceed £A250,000. For the past three years incandescent lamps have been manufactured in Australia by Thorn's subsidiary, Thorn Electrical Industries (Australia) Pty., Ltd., and more recently production was begun on the manufacture of television receivers. Plans are in hand for the manufacture and marketing of radio receivers and, as facilities become available, the other principal products of the Thorn group. With these new activities, Thorn Electrical Industries Ltd. hope greatly to increase trade in the Dominion and thus make a considerable contribution to Australia's rapidly expanding economy.

AEI Lamp and Lighting Co. Ltd.

AEI Lamp and Lighting Co. Ltd. announces that the address of its Bristol area office and stores is now at 1-3, Trinity Street, Bristol 2. (Telephone Bristol 51494/6.)

Trade Literature

PHILIPS ELECTRICAL LTD., Century House, Shaftesbury Avenue, London, W.C.2.—1957-58 lamp catalogue covering tungsten, fluorescent and discharge lamps; vehicle and cycle bulbs; photographic, projector and infra-red lamps.

ATLAS LIGHTING LTD., 233, Shaftesbury Avenue, London, W.C.2.—Technical pocket book on Atlas fluorescent and discharge lighting. Gives full particulars and operating details of all Atlas fluorescent and discharge lamps and their associate circuits including installation and servicing hints. A section on fault-finding is included and technical details are given on lighting fittings. Copies of the pocket book are available, free of charge, to any electrician or engineer.

J. A. WILSON LIGHTING AND DISPLAY, 516-517, G. D. Baldwin Building, Erie, Pa., U.S.A.—Leaflets on their new "Paragrid-Tile" and instructions for installation.

VERITY'S LTD., Plume Works, Aston, Birmingham 6.—"Maxlume" floodlighting equipment catalogue.

ROWLANDS ELECTRICAL ACCESSORIES LTD., Real Works, Hockley Hill, Birmingham 18.—Catalogue of floodlighting equipment.

H. A. GRUBERTS SONNER, 293-299, Kentish Town Road, London, N.W.5.—Catalogue of contemporary fittings made by the parent company in Copenhagen.

FALK, STADELMANN AND CO., LTD., 91, Farringdon Road, London, E.C.1.—Brochure giving details and prices of the "Thames" range of fluorescent fittings designed to provide a range of 30 fittings from a small number of basic parts.

EKCO-ENSIGN ELECTRIC LTD., Preston House, 45, Essex Street, London, W.C.2.—New price list and index of lighting fittings, control gear and accessories.

SYLVANIA ELECTRIC PRODUCTS INC., 1740, Broadway, New York 19, U.S.A.—Folder on reflector fluorescent lamps. Six-page brochure in full colour illustrating fully the "Sylva-Lume" lighting system, Sylvania's newest wall-to-wall lighting.

Personal

MR. R. L. C. TATE has left the staff of the AEI Lamp and Lighting Co. Ltd., where he was field engineer for shops and stores, and has joined Harris and Sheldon (Electrical) Ltd. in a similar capacity. Well known as a lecturer when on the staff of the ELMA Lighting Service Bureau, Mr. Tate is a recognised authority on shop and store lighting and has done pioneer work on the most suitable colour-combinations of filament and fluorescent lamps for display lighting.

MR. J. HUBBLE has been appointed a lamp and lighting salesman in the Leicester office of the AEI Lamp and Lighting Co., Ltd. Mr. Hubble served in the R.A.F. from 1947 to 1955, including two and a half years in Malaya. On leaving the Air Force he joined the B.T.H. Company on a training scheme and joined the Leicester office in June, 1957.

Correspondence

Foot-candle

Dear Sir,—I agree with your comments in your "Notes" on page 257 of the September issue that to use a well-known brand name as our unit might be misunderstood in some quarters.

Not to be outdone in the search for a suitable name, why not use "Trotter"? It would have the merit of being universal in both Europe and America and is closely allied to the somewhat outmoded "foot-candle."

Sussex. M. W. HIME.

POSTSCRIPT By 'Lumeritas'

A FEW weeks ago I came across an article on recent advances in the psychology of vision by an author whose 'letters' included F.E.I.S. Thinking it not unlikely that the author of such an article might be a Fellow of the I.E.S., I supposed the letters after his name to be a misprint of F.I.E.S. However, I was mistaken; F.E.I.S. signifies Fellow of the Educational Institute of Scotland. Owing to the use of this particular permutation of these four letters it will not be very surprising if Fellows of the I.E.S. in Scotland who use their letters are occasionally thought to be not connected with lighting but with enlightening. Coincidentally, it is a Scottish professional institution whose title is such that M.I.E.S. would be ambiguous were these letters to be used by members of the Illuminating Engineering Society. In spite of this, members who hold the newly instituted Diploma in *Lighting Engineering* and who are admitted to Diploma Membership are authorised to write Dip. M.I.E.S. after their names. I hope this will work out all right in practice. The regulations governing the award of the diploma were published last month in the I.E.S. Transactions, but why the diploma should be (very properly) in *lighting engineering* and the name of the body awarding it should continue to be the *Illuminating Engineering* Society is due entirely to the inconsistency of members who voted things that way last March.

THERE are some 'truths' which most of us have discovered by experience and which do not seem to us to need verification by scientific investigations at University level. One such truth is that we can see better in broad daylight than we can in twilight. Another is that it is easier to read moderately large print than very small print in most conditions of lighting. Yet another, I think, is that print is easier to read if its contrast with the paper is strong rather than weak. This latter 'truth' is, however, the principal conclusion drawn by Messrs. R. B. Hackman and Miles A. Tinker—psychologists on the academic staffs of two different American Universities—from their recent experiments with 49 college students. True, they set out to investigate the "Effect of Variations in Color of Print and Background upon Eye Movements in Reading" (Amer. Jour. of Optometry, July, 1957). But, having taken certain "eye-movement" measures, to wit, (a) fixation frequency, (b) duration of fixation pauses, (c) regression frequency and (d) perception time, $= a \times b$, they then observed what each of their seven colour contrasts *looked* like and found that three *looked* weak while the others *looked* strong. The four "eye-movement" measures (really 3, since $d = a \times b$) confirmed this visual impression, that is to say, they showed numerical differences which clearly differentiated the three apparently poor contrasts from the four apparently good ones. Not a word is said about the lighting conditions during the experiments. "The results of the present investigation plus supporting evidence [i.e., results of previous investigations of Tinker *et al.* showing that good contrast gives better legibility than poor contrast] leads to the conclusion that the greater the brightness contrast between printing ink and paper background the greater the legibility of the printed material." Well, as if we didn't know! As a matter of fact the brightness contrast of the experimenters' "stimulus materials" was not measured and so cannot be correlated with the "eye-movement" measures. But you and I, whose ordinary experience led us long ago to the general conclusion so lately reached by these experimenters, will doubtless experience an upsurge of self-confidence now that our conclusion is supported by "scientific" evidence!

IT seems a long time ago since I commented on the objection of the ladies of Nottingham to sodium street lighting—in fact it was five years ago. Now it is reported that, although this kind of lighting is being installed in Nottingham streets, it will not be used in the city centre for fear of spoiling the appearance of feminine make-up. So the ladies have got their own way to a certain extent, and no one will be very surprised by this! Mere man, however, has not been so successful regarding another matter of street lighting. Some time ago Sir Albert Richardson—who is a past president of the Royal Academy—objected to a proposal to erect concrete lamp standards in his home town of Ampthill. He described these standards as looking like "expectant penguins" and thought they would be a blot on the town. Nevertheless, the local council has decided to install the standards and I believe that one of them will actually be sited outside Sir Albert's house!

NEARLY twelve months ago a small amount of faulty material was inadvertently used in the manufacture of over half a million fluorescent lighting capacitors in the United States. These capacitors have found their way into installations all over the country where many of them have proceeded to overheat and burst. Lights have been going out in all sort of places, including hospitals. Capacitors have been hurled across rooms and, even where this has not happened, the filling material has dripped out on office desks and on the clothes of office and other workers. This misfortune is expected to cost the manufacturer hundreds of thousands of dollars for replacements and damages. What havoc trifles can sometimes wreak, since the cause of all the bother is said to be only three parts per million of some contaminant in the filler!

THE recently published Wolfenden Committee's report on homosexual offences and prostitution is not altogether unconcerned with lighting. In paragraph 220 the Committee say, "On a point of detail it has been put to us that the number of lavatory offences would be substantially reduced if all public lavatories were well lighted; but the facts do not seem to support this suggestion, since some of the lavatories at which most of the offences take place are particularly well lit." It is to be hoped that the apparent failure of good lighting in these public place to discourage the commission of homosexual offences will not encourage public lighting authorities to do nothing about improving the lighting of some of these places.

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